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# China Report

ECONOMIC AFFAIRS

No. 377

ENERGY: STATUS AND DEVELOPMENT --XIX

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30 August 1983

## CHINA REPORT ECONOMIC AFFAIRS

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## NATIONAL POLICY

### TECHNICAL, ECONOMIC POLICIES FOR ELECTRIC POWER INDUSTRY PROPOSED

Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 4, 5 Apr 83 pp 65-68

[Article by Li Huasheng [2621 5478 3932]: "Strategies for Increasing the Economic Benefits of the Electric Power Industry"]

[Text] The technical and economic policies for the electric power industry in China should be based on the strategic goals, priorities, procedures and the policies for economic development during the next 20 years as outlined by the 12th Party Congress. In particular, they should be established with the objectives of increasing the economic benefits and raising the standards of science and technology. On the basis of these guidelines, I believe that the following technical and economic policies should be adopted by the electric power industry:

#### 1. Experiences Abroad and in China Show the Electric Power Industry Developing Faster Than the National Economy

During the 20 years in the United States after the power output reached 300 billion kilowatt-hours, the ratio between the rate of growth of the national economy and the growth rate of electric power was 1 : 2; the corresponding ratio in the Soviet Union was 1 : 1.28. In Japan, the ratio during the past 30 years was 1 : 1.12. In this country, during the 28 years since the First Five-Year Plan was initiated, the ratio was 1 : 1.73.

Therefore, in making long-term plans for the electric power industry, it is essential to conduct a careful study of the value structure and product structure in both industry and agriculture, the facilities and power usage of various businesses, as well as the projected increase in the level of electrification and domestic consumption of electricity in order to determine the required growth rate of the electric power industry to meet the demands. This will ensure that continuous development of various aspects of the national economy can be maintained to achieve maximum economic benefits. On the other hand, if the electric power industry cannot meet demands, the national economy will suffer grave consequences. Currently, the production cost of each kilowatt-hour of electricity in this country is 0.065 yuan, and the basic investment cost per kilowatt-hour is 0.2-0.5 yuan; but the industrial output per kilowatt-hour of electricity is approximately 2.0-3.0 yuan, and the revenue generated from each kilowatt-hour of electricity is 0.5-0.6 yuan. These figures clearly show the economic benefits of keeping the electric power

industry in pace with the development of the national economy. Power outages due to inadequate power supplies will result in great loss to industry. According to a survey of industry in Beijing, the loss due to power outage is 20-30 times as great as the cost of power. Statistics collected by the Soviet Union show that the loss is 30 times the cost of power.

## 2. Carrying out the Research and Development of Hydropower To Supplement Other Energy Resources

Developing hydropower for our future electric power needs is a long-range strategy which requires a long-term commitment. Electric power is a secondary energy source, but hydropower provides both primary and secondary energy resources. Specifically, developing hydropower not only saves coal and petroleum reserves, it also yields other benefits such as flood control, irrigation and water transportation.

Based on current project of China's energy situation by the end of this century and beyond, energy shortage is still a critical problem. Future development of petroleum, natural gas and utilization of nuclear energy will be limited; most of the energy development will rely on coal (approximately 70 percent). The development of hydropower will play an important role in solving the energy problem and in developing electric power; it should be part of the study to establish an overall plan of energy development and investment guidelines, and deserves active support and priority consideration. In the past 30 years, the main problem in hydropower development has been inadequate investment. Therefore, establishing a sound investment policy is a key issue in developing electric power to keep pace with the growth of the national economy and in solving the energy problem.

In order to accelerate hydropower development, we must concentrate our efforts on the cascade development of river sections with rich water resources; we must strive to build a large number of hydropower bases within the next 20 years. Specifically, the primary candidates for hydropower development are: the Hongshui He, the middle and upper reaches of the Huang He, the middle and upper reaches of the Chang Jiang (including the three gorges), the Wu Jiang River Valley, the Yalong Jiang, the Dadu He, the Lancang Jiang, and the river systems located in the northeastern, northern and south-central parts of China. We should emphasize the construction of medium- to large-scale hydropower stations, but we should also develop as many small-scale stations as conditions permit.

## 3. Accelerating the Construction of Large-Scale Thermal Power Bases

Because of the abundant coal reserves in this country, most thermal power plants will depend on coal. Therefore, power plants should be constructed near mining regions to coordinate with coal production. Specifically, large-scale thermal power bases should be constructed at the following five surface coal mines: Pingshuo in Shanxi and Yuanbaoshan, Huolinhe, Yimin, and Jungar in Nei Monggol. Furthermore, to accelerate coal production and electric power development, the development efforts should be concentrated at those regions where large reserves of high-quality coal are available and where they can be extracted effectively with a minimum of investment. The primary candidate regions include the northern, central and southeastern parts of Shansi, the Jixi and Hegang regions of northeast China,

the Dongsheng and Haibowan regions of Nei Monggol, the Lianghuai and Yanteng regions of east China, western Henan of central China, the Lingwu and Helanshan regions of Ningxia, the Huibei and Huating regions of Shaanxi, and the Liupanshui region of Guizhou.

At the same time, a large number of medium-size power stations should be constructed at selected railroad centers, shipping ports and locations with heavy power loads. These regions are primarily the Chang Jiang delta region which includes Jiangsu, Zhejiang and Shanghai, the Liaoning region of northeastern China, the Beijing-Tianjin-Tangshan region of northern China, the southern coast of China, and Hunan, Jiangxi, and Fujian provinces.

In order to increase economic benefits, the construction of large-scale thermal power plants should be closely coordinated with the development of coal mines and the planning of transportation systems. In the future, most of the coal produced will be used for power generation, hence coal mining should be concentrated on dynamic coal.

#### 4. Active Development of Nuclear Power Plants and Other new Energy Sources

One of the important measures used by many countries to solve the energy problem is to develop nuclear power plants. In recent years, most industrialized nations consider nuclear power to be an essential approach for developing energy resources. China should make a concentrated effort to catch up with the others and to establish a sound strategy for nuclear power development. As a first step, during the "Sixth Five-Year Plan" period a decision was made to construct a large-scale nuclear power plant in Guangdong Province; plans were also made to develop nuclear power plants in the eastern and northern parts of China where energy resources are inadequate.

The development of wind energy, solar energy, and geothermal energy, is still in the planning and testing stage. When these technologies become more proven, they will be further developed on a regional basis.

#### 5. The Active Use of Large-Capacity, High-Efficiency Thermal Generators and the Implementation of New Technologies

In order to accelerate the development of electric power and to conserve energy in newly constructed thermal power plants, it is essential to develop high-temperature, high-pressure, large capacity, high-efficiency generators. During the "Sixth Five-Year Plan" period, 200 MW and 300 MW generators should be used as much as possible; during the "Seventh Five-Year Plan" period and beyond, 300 MW and 600 MW generators should be used. Efforts should be devoted to the development and understanding of new generator technologies, and to the adoption of foreign technologies, so that large-capacity, high-efficiency and high-quality generators can be produced on a large scale as early as possible.

By using new high-efficiency generators, it is possible to reduce the average coal consumption from 413 g/kwh in 1980 to as low as 323-340 g/kwh. Based on these calculations, approximately 66-85 million tons of standard coal can be saved annually by the year 2000.

The cost of generation is 75 percent of the sales in electricity; for thermal generators, the fuel cost is 74 percent of the total cost. Thus, by decreasing the coal consumption by 73-90 g/kwh, the total cost will be reduced by 9-12 percent. By the year 2000, the annual saving in coal consumption is estimated to be 2.2-2.8 billion yuan.

#### 6. Initiating a Systematic Effort To Renovate the Facilities and Equipment of the Electric Power Industry

At present China has 13 million kw of medium- and low-pressure, condensed gas type generators which are old and inefficient. They consume 13 million more tons of standard coal than the large generators. Facility renovation is an important policy in developing China's electric power industry; it must be carried out with careful planning. The main approach of renovation is to build large-capacity, high-efficiency new generators to replace the existing medium and low pressure generators. In certain cases the medium and low pressure generators can be modified to serve as heat producing generators, or may be moved to locations which are difficult to reach but are rich in coal reserves.

#### 7. Active Development of Thermal Electric Stations in Order To Increase the Overall Efficiency of Energy Utilization

A thermal power plant produces both heat and electricity. It can increase the efficiency of thermal generators by 30-50 percent. At present, China has only 4.6 million kw of heat-producing generator units, which is less than 10 percent of the thermal generators, but they are saving 5-6 million tons of raw coal each year. The Soviet Union has the highest thermal efficiency of power generation in the world because 35 percent of its generators are heat-producing generators. In China, a concerted effort should be made to develop thermal electric stations in regions with heavy concentration of industrial heat loads and favorable technical and economic conditions.

A careful study of the type and capacity of heat-producing generators should be conducted. The pumped-gas back-pressure type generators currently being developed can be used under most conditions. The large condensed-gas type generators with heat ports can also be used in situations of concentrated heat loads. In addition, it is necessary to study the problem of designation of heat-producing generators.

#### 8. Development of Electric Networks To Increase Economic Benefits

Developing electric networks has become a common experience started by many countries because it allows the efficient utilization of many different energy sources and reduces the requirements for maintenance, repair, and emergency standby equipment. By taking advantage of the time differences of a large network, it is possible to reduce the peak loads; also, by installing large-capacity generators, it is possible to regulate the load between fire-powered and hydro-powered generators, and to regulate the reservoir levels for different river regions. Not only does an electric network accelerate the development and reduce the cost of power generation, it also improves its quality and reliability. Therefore, the technical and economic benefits are quite obvious.

Currently under study is a project to construct an electric power grid linking central China and eastern China. Once completed, not only will it be able to deliver electricity generated by hydraulic or thermal power from central China to the energy-poor eastern regions, requirements for maintenance and emergency equipment can also be reduced. In addition, the benefits of reduced peak load and regulated electric power between hydraulic thermal generators will allow a reduction of 500,000-700,000 kw of generating capacity.

The Henan-Hebei grid currently under construction will reduce power losses by 0.3-0.5 billion kilowatt-hours in case of a serious system malfunction; it will also improve the reliability of power supply.

The already completed network linking Henan and Hubei will increase the overall power output by 200,000-300,000 kw.

Another major reason for developing electric network is to solve the problem of uneven distribution of energy resources and electric loads, and to overcome the difficulty due to transportation limitations. The economically more developed regions of the eastern shores, northern China, and the Beijing-Tianjin-Tangshan corridor are the old industrial bases of this country. Currently the industrial and agricultural output of these regions account for 70 percent of the national output, and the potential for future development is quite good. But these regions are poor in energy resources. On the other hand, the neighboring provinces of Shanxi, Nei Monggol and the northwest, southwest, and south-central regions have abundant energy resources. Therefore, in order to meet the power requirements for economic development along the coast, it is necessary to establish a network to deliver electricity from west to east. The establishment of electric networks increases the economic benefits of energy utilization and energy distribution.

During the "Sixth Five-Year Plan" period, we should expand the six regional networks in northeastern China, northern China, eastern China, central China, northwestern China and southwestern China, and rebuild the network in southern China. A portion of the regional networks will be linked together. During the "Seventh Five-Year Plan" period and beyond, as large-scale hydro and thermal electric bases are developed, the corresponding regional networks will be further connected. The central and eastern regions, the northwestern and northern regions, the northern and northeastern regions, and the southwestern and southern regions will all be linked by high-voltage transmissions lines. These networks will be the foundation on which a national network will subsequently be built.

Developing a large electric network requires careful study of the energy balance among various regions, the distribution of electric loads, the transportation system, and the conditions for improving the quality and reliability of power supply, so that an optimum plan can be implemented to achieve maximum technical and economic benefits. It is also necessary to consider the approach and procedure of peak load regulation, load balance under idle conditions, and the approach for voltage regulation.

To meet the requirements of large electric networks, an effort must be made to actively pursue and become knowledgeable in ultra-high voltage transmission technology and transformer technology.

## 9. Reducing Unit Investment in Construction and Operating Cost

The use of large-capacity thermal generators is an important measure to reduce unit construction investment, reduce energy consumption and increase production efficiency.

Based on experiences in the Soviet Union and in this country, the unit investment in construction can be reduced by 5-10 percent for each step increase in generating capacity. However, in order to ensure the reliability of electric power systems, the generating capacity should not be excessive. On the basis of the current trend in network development in China, the generating capacity for the next 10 to 20 years should be in the range of 200,000 to 600,000 kw.

In building thermal power plants, we must use advanced design and construction techniques, strengthen the organization and management of the design and construction team, reduce construction time and minimize cost.

We must solve the problem of water conservation for large-scale thermal power plants and we must become knowledgeable in air cooling technology, so as to build power stations in coal regions where water is in short supply.

In conjunction with China's economic development, we must also investigate the problem of environmental protection for thermal power plants. Specifically, we should consider the active use of new technologies, new processes, and new equipment which produce a minimum amount of pollution. For coal-fired power plants, we should establish a comprehensive plan for residue treatment which include the construction of a residue dump site and the synthetic use of residues.

In hydropower construction, we should concentrate on cascade development of rivers with favorable conditions; we should simultaneously develop large, medium and small hydropower stations; we should also develop both reservoir stations and flow stations. Furthermore, in addition to power generation, we should consider other benefits of hydropower such as flood prevention, irrigation, urban and industrial water supply, water transportation, and marine products.

On the basis of needs, we should take steps to develop large-capacity, high water head mixed flow type or impact type generators, and low water head bulb-type generators, as well as hydroelectric generators with pumped-water energy-storage features.

We should study new technologies in hydroelectric construction such as advanced geological survey techniques, techniques for building tall dams and deep foundations, techniques for constructing large-diameter long tunnels, and the treatment of tunnels in karst. We should also study techniques for accurate hydrological forecast and the problem of maximum flood water, and establish a comprehensive standard for flood prevention.

## 10. Developing Electric Power for Rural Use

Currently, only half of the rural production brigades in China use electricity for irrigation, processing of grains, cotton, and oil, various commune industries, and cultural activities. It plays an important role in promoting farm productivity

and increasing the farmers' standard of living. However, the other half of the production brigades have no electricity. To solve this problem requires persistent and dedicated efforts. During the next 20 years, we should strive for rural electrification which is compatible with the goal of a moderately affluent standard of living. The electrification of China's farm villages depends on both government policies and self-reliant efforts to develop multiple energy sources. The government should be responsible for the construction of large and medium power stations while small stations should be built by local communities. The electricity used by today's farm villages is primarily supplied by large national power grids. But due to the vast territory of this country, a large part of the countryside must rely on local communes and brigades to develop small-scale hydropower, thermal power, and wind power. The most practical and most economical approach is to develop small hydropower because there are abundant hydroelectric resources in this country, particularly in the southern mountain regions. We must actively carry out the policy of "self-construction, self-management and self-utilization." The funds required for electric power construction should be obtained from local communities in the form of contributions or investments, with appropriate financial support from the government in the form of long-term, low-interest loans or other assistance.

#### 11. Complete and Systematic Reform of the Management Structure To Satisfy the Needs of the Developing Electric Power Industry

Because the electric power industry carries out the functions of production, supply and sales at the same time, it is logical from the point of view of safety and economy to have a highly centralized management structure. This indeed is a common trend adopted by many countries. In recent years, a great deal of work has been done in this country toward a centralized and unified management system, but there is still need for further improvement.

Based on China's current situation, active participation by local communities in the development effort must be encouraged in conjunction with the establishment of a centralized management system. Local support is essential in the production and distribution of electric power, in the construction of power plants, and in the welfare of the personnel. We must establish guidelines and policies with regard to equipment procurement, retained earnings, tax revenues, etc., and with regard to the responsibilities and benefits of local communities in terms of electric power distribution, in order to encourage local participation in the production and management of the power industry.

We must change the planning and management system of the electric power industry. We must focus on financial planning and establish a multi-level management system. We should introduce basic reform in the construction system to have complete control of the investment, quality and schedule of a construction project. Besides government construction investment, we can expand the sources of funds by considering other methods such as joint ventures, energy taxes, electric utility taxes, or installation charges. We should change the methods of industrial management to allow the industry more freedom to develop its own production capacity and potential. We should change the pricing system for electricity and heat in accordance with peaks and valleys in electric loads, as well as seasonal fluctuations in water levels. We should modify the present procedures and regulations to

comply with the requirements of the four modernizations; we should also introduce reforms in scientific research and experimentation with emphasis on making progress in scientific techniques and increasing economic benefits in order to provide better service to the electric power industry.

Complete and systematic reforms should also be carried out in other areas such as labor wage structure, education and personnel training.

## 12. Increasing the Level of Automation

The development of electric power systems with their large generating capacities place higher demands on automation, from which ever-increasing economic benefits can be derived. The basic objectives of automation in the electric power industry are: improving the safety of power generation and supply; ensuring the quality of electric energy; increasing the reliability and efficiency of power plants and electric networks; and reducing labor intensity and increasing work efficiency.

We should study automation techniques for the operation of hydropower stations, thermal power plants, and power grids. We should use electronic computers in large networks and large stations to perform such tasks as data processing, load distribution and determining the optimum mode of operation. We should also devote our efforts in the study of automation techniques in information management, software development and the application of micro-computers in performing administrative tasks.

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CSO: 4013/220

## POWER NETWORK

### WEST-EAST POWER TRANSMISSION PRESENTS MAJOR TECHNICAL PROBLEMS

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 5, 12 May 83 pp 5-6

[Article by Wang Bing [3769 0393] of the Water Conservancy and Hydropower Construction Company: "Beginning Early Studies on Transmission of Power From West to East China"]

[Text] In her interview with SHUILI FADIAN, Minister Qian mentioned the question of transmitting power from west to east China. This is a major technical problem that must be solved in order to achieve the goal of quadrupling hydropower production.

Almost all the hydraulic energy resources in China are concentrated in the southwest, northwest, and central south region, whereas the load centers are in the east, northeast and north China. The load demand on the power grid is growing very fast and it has become increasingly difficult to transmit the hydropower generated in the southwest and northwest over long distances, in large quantity, through high-voltage transmission lines to the east. For example, the Erjiang power plant in the first phase of the Gezhouba project will come on line in 1983, the total capacity is 965,000 kW, the existing 220 kV circuit for transmitting power to Hubei Province is no longer adequate and 500 kV circuits must be used to deliver the power to other provinces. After the completion of the second phase of the Gezhouba project, the total capacity will be 2.715 million kW and the power must be delivered to the east at even higher voltages or via DC transmission lines. If the Sanxia power station is built before the year 2000, a nationwide power grid centered at Sanxia will eventually be formed to connect the major power grids in the southeast, central south and east China. This would not only solve the problem of an increasing load in power shortage regions and reduce demands on coal and transportation, it would also promote an accelerated development of hydropower and the advantages of a parallel operation of hydropower and coal power. Abroad, many countries in Europe employ superhigh voltage or DC transmission lines to deliver power across borders, and they also take advantage of the interplay between hydropower and thermal power to improve the reliability and economy of the electric power supply. With the exception of Iceland, due to its remote location, the other four north European countries--Denmark, Finland, Norway, and Sweden--have already connected their power grids. The electric power structures of these four countries are quite different, Norway has almost all hydropower, Denmark has only thermal power, Sweden has half and half, and in Finland the

hydropower accounts for 20 percent. They are connected by 16 high-voltage circuits to exchange electric power and to solve the problem of low-water seasons in countries where hydropower is predominant and also to solve the peak and valley problem in countries where coal and nuclear power are predominant and each country benefits from the joint operation. The voltage of the connected power grid includes 132, 220, 275 and 400 kV AC and  $\pm 250$  kV DC, with an exchangeable capacity of 800 kW; 13.3 billion kWh were exchanged in 1981.

In order to coordinate the production, distribution and consumption of electric power in the five north European nations and to study the utilization and development of electric power resources, the North Europe Electric Power Organization (Nordel) was established in 1963 and the participating countries take turns in serving as the chairman and secretary. Based on this foreign experience, we should put the transmission of power from west to east China on the agenda in order to accelerate the development of hydropower and to gradually place the priority on hydropower. For this purpose, we propose that: 1) We thoroughly strengthen the planning of the electric power system. Since the power transmission from west to east China has exceeded the scope of existing large region power grid management bureaus and the related design institutes, we suggest that a planning effort be made to study cross-regional electric system using technical personnel in both hydropower and thermal power; 2) Together with the State Science and Technology Commission and the Ministry of Machine Building Industry, an early study should be made to determine the transmission line voltage for DC transmission and research should be conducted in the areas of power transmission equipment, test manufacturing, system stabilization, automation, communications, and maintenance.

9698

CSO: 4013/234

## POWER NETWORK

### NEW POWER PLANTS SPUR EXPANSION OF SHAANXI-GANSU-QINGHAI GRID

OW060205 Beijing XINHUA Domestic Service in Chinese 0741 GMT 1 Jul 83

[Text] Xi'an, 1 Jul (XINHUA)--Shaanxi, Gansu, Ningxia and Qinghai, three provinces and one autonomous region considered poor and backward in the past are now developing at a steady pace and becoming rich in energy resources. This was my deep impression as I covered the academic symposium on the exploitation of energy resources in Northwest China which just concluded in Xi'an.

According to statistics of the power generation department, the current total daily power output of power stations in Shaanxi, Gansu, Ningxia and Qinghai, with a total installed capacity of more than 5 million kwh is much higher than that for the whole year in these areas prior to liberation. The Shaanxi-Gansu-Qinghai power grid has become China's fifth major power network. From 1976 to May of this year the Shaanxi-Gansu-Qinghai power network, the Ningxia power network, and the Bikou power plant in Gansu, which have not yet formed a power grid, have supplied nearly 10 billion kwh of electricity to the neighboring provinces and autonomous regions of Sichuan, Nei Monggol, Shanxi, Henan, and others.

These areas, which possess rich energy resources, are still under development. They have the following special features:

They have abundant resources. In the upper and middle reaches of the Huang He and along the Han Jiang and Bailong Jiang, hydraulic power reserves amount to as much as 51 million kva--the second largest in the country, only next to that of Southwest China. They also have large reserves of coal which is not too deeply buried below the surface. The coal is of high quality, thus providing favorable conditions for the development of thermal power generation.

Many large and medium-sized hydroelectric and thermal power plants (stations) have formed a power grid. The total installed capacity of the Liujiaxia, Yanguoxia, Bapanxia and Qingtongxia hydroelectric power stations on the upper reaches of the Huang He is close to 2 million kw. The total installed capacity of the Shiquan hydroelectric power station on the Han Jiang and the Bikou hydroelectric power station on the Bailong Jiang is 435,000 kw. In recent years we have also newly built and expanded the Hancheng Power Plant, the Qingling Power Plant, the Liancheng Power Plant and other large thermal power plants with a total current installed capacity of 1.05 million kw.

Economic efficiency is higher with the hydraulic and thermal power plants forming a joint power grid. The average cost of generating 1 kwh of electricity in these three provinces and one autonomous regions is 23 percent lower than the national average.

The number and scale of the power generating projects now under construction are unprecedentedly large in these three provinces and one autonomous region. They will play a decisive role in building China's power industry. The Longyangxia Hydroelectric Power Station, the Ankang Hydroelectric Power Station, the Qingling Power Plant, the Dawukou Power Plant, the Qiaotou Power Plant and other power stations that are now under construction have a total installed capacity fo 3.18 million kw. Among these power stations, the Longyangxia Hydroelectric Power Station is also the largest key water conservancy project on the Huang He.

CSO: 4013/267

## POWER NETWORK

### UPDATE ON CONSTRUCTION OF DATONG POWER PLANT, TRANSMISSION LINE

SK081247 Taiyuan SHANXI RIBAO in Chinese 10 Jun 83 p 2

[Text] The Datong No 2 power plant is situated in the southern suburbs of Datong City. The designed capacity of the first-stage construction of this plant is 1.2 million kilowatts, and the second-stage construction is scheduled to be 2.4 million kilowatts. This power plant has been designed and is being constructed by China. After the completion of the first-stage construction, this power plant will annually provide 8 billion kilowatt-hours of electricity to Beijing, Tianjin and Tangshan via the 500,000-volt superhigh-tension power transmission line between Datong and Fangshan.

The Datong No 2 power plant is a large power plant constructed near a coal mine, which is aimed at giving full play to our province's superiority and at making full use of the rich coal resources in Datong City. According to its design, this power plant will be composed of 8 major units comprising 190 construction projects. The main building of the plant is 62 meters high with a 210-meter-high stack and an 85-meter-high cooling tower. Six power generators, each with a capacity of 200,000 kilowatts, will be installed in the main building of the plant. Of this, the No 5 and No 6 generators will be equipped with foreign cooling systems.

The Datong No 2 power plant was designed by the Provincial Power Survey and Design Institute and is being constructed by the First Provincial Construction Company. The main furnace and equipment will be manufactured by the three power machinery plants in Sichuan. This project was started in October 1978 and so far, some 3.025 million cubic meters of earth have been moved, 216,000 cubic meters of concrete have been poured and 26 kilometers of highways and railways, and temporary structures for production and daily life with an area of 110,000 square meters have been completed, amounting to an investment of some 20 million yuan. The earthwork for the No 1 generating unit is about to wind up, and installation is being vigorously carried out. Projects of water supply, dust elimination, coal transport, and pipeline installation are being organized and carried out at the same time. The main earthwork and installations of the No 2 power generating unit and the earthwork of the No 3 and No 4 generating units are being appropriately speeded up.

Spanning the summit of Heng Shan and the perilously high peaks of Taihang Shan, the construction of the Datong-Beijing 500,000-volt superhigh-tension power transmission and transformer project--currently the largest power artery in North China--is being vigorously carried out. This large power artery will extend westward from the new power plant in Datong, the ancient city north of the Great Wall, eastward to the 500KV substation in Fangshan in Beijing, the capital. It passes through Shanxi and Hebei provinces and Beijing Municipality with a total length of 286 km. The Beijing section of the project was started in July 1981. The Shanxi section of this project, 103 kilometers in length, was undertaken by the Shanxi provincial power transmission and transformer construction company and was initiated on 27 April 1982. At present, the basic concrete pouring work of the 742 pylons along the power transmission line has been basically completed, and the whole project is expected to be basically completed by the end of this year. Beginning next year, a strong current will be transmitted from Datong in Shanxi to the power networks in Beijing, Tianjin and Tangshan by way of this power artery. The power transmission capacity will reach 800,000 to 1 million kilowatts, an equivalent of transporting 10,000 tons of standard coal per day to Beijing. This will enable the power networks of Beijing, Tianjin, and Tangshan to increase their power supply capacities by 16 to 20 percent. This project is of great significance in alleviating the present strained power supply situation in Beijing and Tianjin, promoting modern economic construction, and satisfying the daily needs of the people.

The construction of this 500,000-volt superhigh-tension power transmission and transformer project requires advanced technology. At present, only a dozen or so countries in the world have such projects, and very few countries can design and manufacture their own equipment and materials. The Datong-Beijing 500,000-volt power transmission and transformer project now under construction is Chinese designed, and most of the equipment and materials are being made domestically with the exception of a small amount of imported transformer equipment.

According to the relevant departments, after completing the construction of this 500,000-volt superhigh-tension power transmission and transformer project, beginning next year, construction of another Datong-Beijing 500,000-volt superhigh-tension power transmission line and the 500,000-volt superhigh-tension power transmission line between the Shentou Power Plant and Datong will be initiated so as to expand the power supply capacity to 2.55 million kilowatts.

CSO: 4013/274

## POWER NETWORK

### BRIEFS

NATIONAL POWER OUTPUT QUOTA--Beijing, 23 Jun (XINHUA)--China's power industry produced 161.5 billion kilowatt-hours of electricity by 22 June, exceeding the semi-annual quota 8 days ahead of schedule, according to the Ministry of Water Resources and Electric Power. The figure represents a 5.77 percent increase over that of the same 1982 period, a spokesman for the ministry said. Hydroelectric power stations across the country generated 8.81 billion kilowatt-hours of electricity above the state quota in the first half of 1983, as a result of good rainfall to date. From January to May, the spokesman said, the country's thermal power plants with a generating capacity exceeding 6,000 kilowatts conserved 450,000 tons of coal by cutting their coal consumption per kilowatt-hour of electricity by 3 grams, compared with the same 1982 period. [Text] [OW280105 Beijing XINHUA in English 0745 GMT 23 Jun 83 OW]

500 KV POWER LINE CONSTRUCTION--Wuhan, 23 Jun (XINHUA)--Six 500,000-volt electric power transmission projects are being built in China, and six more of the same capacity are being designed. This was reported at a national meeting on the building of ultra-high voltage power transmission projects held earlier this month in Wuhan, capital of Hubei Province. The lines are now necessary because China is building exceedingly big hydroelectric power stations and thermal power plants. One of these is the mammoth Gezhouba Hydroelectric Engineering Project being built on the Chang Jiang in Hubei Province. A 500,000-volt transmission line is being put up to link Gezhouba with Wuchang, a district of Wuhan. Ultra-high voltage transmission lines are found in no more than a dozen countries in the world, the meeting reported. [Excerpt] [Beijing XINHUA in English 1404 GMT 23 Jun 83 OW]

SHANXI-BEIJING POWER LINE--Beijing, 21 Jun (XINHUA)--Construction on a 500,000-volt high-tension transmission line running from Datong, a coal mining center in Shanxi Province, to Beijing, the capital, is in full swing, according to the power department. To date, erection of 740 pylons along a 286-kilometer-long route, has been completed. The transmission line, designated as one of the 70 top-priority construction projects for the current 5-year plan, is expected to be completed by the end of this year. When completed, the facility will transmit electricity generated by the thermal power plant near a coal mine in Datong to the capital. The new line will help alleviate power shortage in Beijing, Tianjin and Tangshan, industrial centers in the North China Plain. [Excerpt] [Beijing XINHUA in English 0731 GMT 21 Jun 83 OW]

HUBEI POWER LINE--Wuhan, 18 Jun (XINHUA)--Work began today on a 144-kilometer section of a 220,000-volt power transmission line in Hubei Province. The project, scheduled for completion in October, will be linked with the other section of the line--200 kilometers--which has been completed in Hunan Province. The 344-kilometer power transmission line will usher in the completion of a power grid in central China, which encompasses Hubei, Hunan, Jiangxi, and Henan provinces. [Text] [Beijing XINHUA in English 1532 GMT 18 Jun 83 OW]

JILIN TRANSMISSION PROJECT--The construction of a 220,000-volt power transmission and transformer project which includes three transmission lines from Baishan to Siping, from Jilin to Sulan, and from (Zhenbohu) to Yanji via Dunhua with a total length of 590 kilometers is in full swing. This project is one of the important subsidiary facilities of the Baishan hydroelectric station. The completion of the two transmission lines from Jilin to Sulan and from (Zhenbohu) to Yanji will play an important part in assuring a power supply to the Changchun and Yanbian minority areas. [Summary] [Changchun Jilin Provincial Service in Mandarin 1030 GMT 22 Jun 83 SK]

HUNAN POWER TRANSMISSION PROJECT--The construction of the 220,000-volt power transmission and transformer project of the Hunan-Hebei combined power grid within Hunan Province was completed on 8 May, 2 months ahead of schedule. This project covers an area from Wuchang in the north to Changsha in the south. The project includes 340 km of 220,000-volt power transmission lines, 201 km of which is in Hunan and passes through five counties and cities, including Ningxiang, Yueyang, Pingjiang, Miluo, and Changsha. This project was designed by the Hunan Provincial Power Survey and Design Institute and constructed by the provincial electricity transmission and transformer construction company. With the support of relevant prefectural, city and county governments and relevant units, it took only 114 days to complete the construction of this project. After the completion of the combined power grid, electricity generated by the Gezhouba Hydroelectric Power Station will be transmitted to Hunan Province, thus further improving the supply in the province, particularly Yueyang Prefecture and Changsha, in winter. [HK220726 Changsha Hunan Provincial Service in Mandarin 2310 GMT 18 May 83 HK]

CSO: 4013/273

## HYDROPOWER

### SPECIALISTS PROPOSE WAYS TO QUADRUPLE HYDROELECTRIC OUTPUT

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 4, 12 Apr 83 pp 7-8

[Article by Chen Shandkui [7115 0006 1145]: "Specialists, Scholars Suggest Ways To Achieve Quadrupling of Hydroelectric Output"]

[Text] On the eve of the new year, the Chinese Society of Hydroelectric Engineering and the Water Conservancy and Hydropower Construction Company held a forum and invited managers and persons in charge of special committees as well as old comrades, specialists, and professors engaged in hydropower construction and technology to participate. Li Eding [2621 7725 7844], Chen Gengyi [7115 6342 0308], Shi Jiayang [2457 0857 3568], Zhang Guangdou [1728 0342 2435], Zhang Tiezheng [1728 6993 6927], Zhang Changling [1728 2490 7881], Cui Zongpei [1508 1350 1014], Lin Bingnan [2651 4426 0589], Tan Xiudian [6009 0208 0368], Huang Wenxi [7806 2429 3556], Ma Junshou [7456 0689 1108], Liang Yihua [2733 4135 5478], Cheng Xuemin [4453 1331 2404], Ji Yunshen [4764 0061 3932], Wu Shide [0702 1597 1795], Yu Kaiquan [0060 7030 3123], Zhu Baofu [2612 1405 8119], and about 90 others attended the meeting. The participants assembled, drank green tea and freely discussed the great achievements and the bright future of China's hydroelectric construction and suggested ways to create new prospects. The discussions were centered around Minister Qian Zhengying's [6929 2973 5391] interview by "Shuili Fadian."

Comrades at the meeting agreed that Minister Qian, in his interview with "Shuili Fadian" magazine, made clear the strategic goal of quadrupling hydropower production in 20 years and has drawn up a magnificent blueprint for China's hydroelectric development in this century, which is highly significant in guiding hydroelectric construction in the future. Everyone was greatly encouraged and full of confidence. Most of these veteran comrades and specialists who have struggled several decades for China's hydropower and made important contributions, are now over 60 years old, some over 70, but their spirit is still high and they are eager to make active contributions to turn this magnificent blueprint into reality. In the discussion, many constructive suggestions were put forward. In the space below we shall list some of the important suggestions.

(1) Continue To Publicize the Importance and Urgency of Accelerating the Development of Hydroelectric Power.

Electric power construction is one of the most important tasks in the four modernizations; it not only involves economic issues but is also directly related to the advancement of social ethics, education, and culture. Without progress in electric power, there would be no hope for the four modernizations. Electric power development requires primary energy resources. According to the current ratio of hydroelectric and thermal electric power generation, more than 500 million tons of coal will be burned by the year 2000, or more than 70 percent of the total production of China's large and medium coal mines. This is clearly impossible. China has extremely abundant water energy resources for hydropower development. On the surface, the cost per kilowatt-hour is higher and the construction time is longer for hydropower than thermal power, but when the coal mine and railroad investments are included in the thermal power cost, the investments are comparable. Building a new million-ton coal mine also takes 7 or 8 years and it is no less difficult than building a hydroelectric station. In addition, there are also water supply and transportation problems in thermal power development. We hope that this is fully understood by the policy-making bodies and the development of hydropower is actively supported. Only when effort is put into such areas as planning, investment, material, and equipment, will the development of hydropower be accelerated and the goal of quadrupling output achieved.

## (2) Further Clarify the Policy of Hydropower Construction.

First, we should develop hydropower stations at those sites with good economic conditions (low construction cost and low investment), small flooding loss, favorable geographic location, and convenient transportation. For rivers with abundant hydroelectric resources and good development conditions, we should concentrate our effort on cascade development. Next, we should develop large, medium, and small hydropower stations simultaneously. Some major projects should be started as soon as possible to serve as a skeleton for the development effort, for without constructing large hydropower stations the goal of quadrupling hydroelectric output would be impossible to achieve. In the meantime, medium and small stations should be developed according to local conditions. Local resources and local investments should be mobilized to build a number of medium-sized hydroelectric stations.

## 3. Actively Pursue Reform.

Reform should be conducted in all phases of the development, including construction, research, survey, design, management methods and technological economic policy. The emphasis should be placed on the contract practice. Survey, design, construction, and research can all be contracted. Engineering survey, design and construction jobs may be opened to bidding to let the design institutes and engineering bureaus compete. A new prospect in hydropower can be created by reform and by getting rid of the old practices of "eating out of the big pot" and the "iron rice bowl." The contract system and the construction work tried at Hongshi and Daliushui by the Min Jiang Hydroelectric Engineering Bureau showed clear superiority and the experience should be consolidated and promoted. In terms of economic policy, the price of electric power should be raised to speed up the turnover of

hydropower investment. Investments should be shared according to the benefits in the integrated utilization of the hydropower stations such as improved flood prevention, irrigation, and shipping. Some of the income of the hydroelectric stations should be shared with the local area to encourage local participation in the construction of hydropower stations. Also a sensible policy regarding migrant workers should be established.

#### (4) Work on the Early Phase of Hydropower Construction and Formulate Long-Term Development Plans.

Long-term development plans are of crucial importance; they determine the feasibility of the construction and the magnitude of the economic return. A mistake in planning can lead to a loss of several hundred million yuan rather than several hundred thousand or a few million yuan. We have learned plenty of lessons in this regard. We suggest that the Ministry of Water Resources and Electric Power come up with a long-term hydroelectric development plan as soon as possible and a priority plan to develop rivers in this century. The survey and design tasks should not only complete the preliminary design of construction projects for the first 10 years but also make preliminary designs for projects that will be started during the second 10 years.

(5) The Sanxia Hydroelectric Power Station on the Chang Jiang is a huge project that has attracted worldwide attention. The Sanxia project will usher in a new era for China's hydroelectric industry. The Party Central Committee has determined that the construction work should begin in the near future; we are all for this decision and are very encouraged by it. But the Sanxia project is a very difficult task and many complex technical and economic problems remain to be solved. A sensible development guideline should be established. In solving these problems, we must on the one hand organize a cooperative effort in technology (including institutes of scientific research, design, and construction, and colleges and universities) to strive for technological breakthroughs and to solve the technical problems and on the other hand we must also widely accumulate funds and study the feasibility of issuing Sanxia Hydropower Station construction bonds in China and abroad. Finally, we should adopt the method of phased construction used for Gozhoubu so that we may have the benefit of electric power production while the construction continues.

#### (5) Accelerate Technological Advancement in Hydropower Construction.

First, we should strengthen scientific research in design and survey and actively incorporate domestic and foreign new technologies, theories, material, equipment, methods, and management. Second, we must concentrate on technological legislation, refining the various regulations and codes (85 of them have already been published or are in the process of being published). Third, we should let the intellectuals play an important role and reform the hiring and wage system so that more intellectuals will be attracted to the hydroelectric field. Finally, we must cultivate secondary vocational school graduates and technical workers so that they will join the college graduates in forming a strong rank for hydroelectric construction.

(7) Make Good Use of the Hydroelectric Stations Already Built.

Since 1980 there has been a collaborative effort by production, design, and construction departments to strengthen the management of hydropower stations, to improve the final phase of the construction work, and to correct mistakes. With proper economic management, normal production has been maintained in the last 3 years and most of the potential has been developed. With new generators joining production, hydropower production in 1982 was 20 billion kwh more than the 1979 output, an increase of 45.7 percent. This production increase has contributed greatly to the overfulfillment of industrial quotas in the last few years even though the supply of coal has been insufficient. But due to such problems as generation equipment quality building flaws, tailwater sediment, transmission lines, and migrant workers, there is still about 1 billion kwh of potential in the present hydroelectric output which should be actively developed.

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CSO: 4012/223

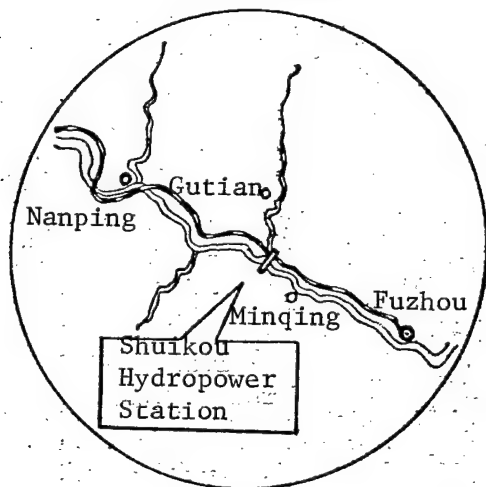
## HYDROPOWER

### PROPOSED SHUIKOU PROJECT WOULD PROMOTE INDUSTRY, DISPLACE FEW PEOPLE

Fuzhou FUJIAN RIBAO in Chinese 30 Jun 83 pp 1, 4

[Summary] In July 1982, the State Scientific and Technological Commission convened the Shuikou Hydroelectric Power Station Environmental Impact Conference attended by experts from the State Planning Commission, the State Economic Commission, the Ministry of Urban and Rural Construction and Environmental Protection, the Ministry of Communications, the Ministry of Agriculture, Animal Husbandry and Fishery, the Ministry of Geology and Minerals, the Ministry of Water Resources and Electric Power, The Chang Jiang Water Resources Protection Agency, Qinghua University, Fujian Teachers University, Shanghai Academy of Aquatic Products, the institutes of Geology, Hydrobiology, and Hydraulic and Hydroelectric Science of the Chinese Academy of Sciences, the Institute of Comprehensive Transportation of the State Planning Commission, and the Provincial People's Government. The Conference heard the report of the East China Survey and Design Institute of the Ministry of Water Resources and Electric Power and discussed the "Investigative Study Report on the Environmental Impact of the Construction of the Shuikou Hydroelectric Power Station" drawn up by the Institute. Officials of the Provincial Planning Committee and the Provincial Water Resources and Electric Power Department expressed their satisfaction with the content of the discussions and the answers to pertinent questions.

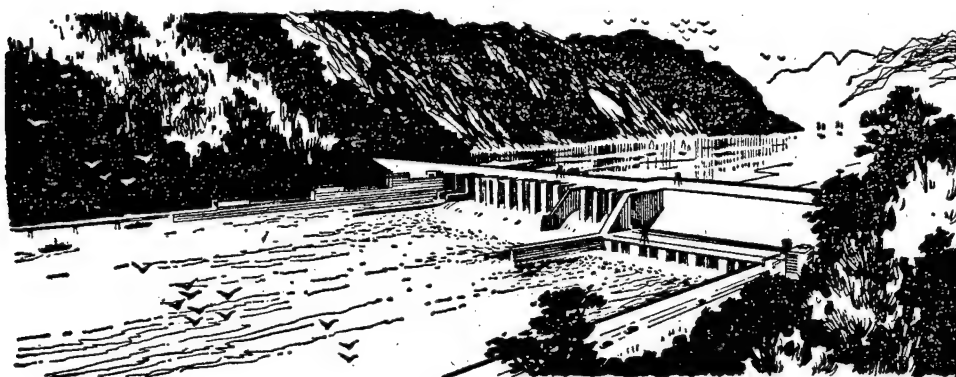
The development formula calls for the complementary promotion of both electric power generation and shipping, with the major emphasis of the former, an approach deemed rational by those attending the conference. The mainstream of the Min Jiang is a major transportation artery in Fujian Province, but because of its precipitous banks, its many shoals and rapids, and its meandering channel, vessels of only 50 to 80 tons can navigate it during the course of a normal year. The construction of the Shuikou hydropower station will greatly improve this situation. The channel will be open to deep-water shipping for 100 kilometers above the dam site and the volume of water will be increased downstream as well. Shuikou will be provided with locks capable of passing vessels of 500 tons for an annual volume of shipping of 3.2 million tons. The station will maintain a specified basic load, generating power 24 hours a day, 12 months a year, assuring a basic water depth for shipping.



Installed Capacity.....1,400 MW  
 Yearly Output.....4.95 Billion KWH  
 Lock Capacity.....500 Tons  
 Reservoir Capacity..2.34 Billion m<sup>3</sup>  
 Dead Storage Capacity..1.64 Billion m<sup>3</sup>

The extent of the impact on the ecological environment will be determined primarily by the extent to which the river's natural hydrological conditions are altered. This, in turn, will be determined by the regulatory operations and the storage capacity. The Shuikou Reservoir has a total capacity of 2.34 billion cubic meters and a dead storage volume of 1.64 billion cubic meters. With a capacity of 700 million cubic meters, the regulatory reservoir has a capacity coefficient of only 1.28 percent, a rather small capability that will provide only partial regulation during the dry season. During the rainy season, Shuikou will function as a run-off power station and as floodwaters will be discharged as they accumulate, the environmental impact will be minor.

Delegates attending the conference were unanimous in their concern over what impact the building of the hydropower station would have on the fishing industry. Given the fact that the volume of water entering the Shuikou Reservoir is large and the capacity of the reservoir small, the content of nutrients and organic matter in the discharged water will remain largely unchanged so the downstream fish population will not lose its food base. The majority of delegates thus saw no serious problems posed to the fishing industry in the Min Jiang Estuary. The only major problem for this industry after the Shuikou dam has been built is that the natural route for fish that return upstream to spawn will be interrupted and their breeding habits disrupted. The Provincial Aquatic Products Department proposed that a fingerling station be provided within the reservoir and boats stationed below the dam to collect and transport the fish. An investigation of the Danjiangkou Reservoir has shown that as a result of artificial breeding, the fish population in the reservoir area actually increased and the fish production downstream remained stable. The delegates thought it would be feasible to adopt these same measures at Shuikou, where the construction of the dam will make available an additional 100,000 mu of water area to expand the fishing industry.



An artist's sketch of the completed Shuikou Hydroelectric Power Station.

The building of the Shuikou Reservoir will result in the loss of 100 million cubic meters of water a year through evaporation, but except for this, all of the natural volume of water will pass over the spillway or through the power station so that the volume of water downstream will not be appreciably diminished and the tides will be unable to advance upstream. As the flow of water will actually increase during the dry season, irrigation water will not become more saline after the dam has been built. The reservoir of Shuikou will intercept only the coarse grains of silt; the finer grains, minerals, and organic matter will be discharged along with the water to provide fertilizer and nutrients for the cropland, orchards, and fish ponds downstream. The conference concluded that there would be no disadvantages for agriculture at all.

Nanping City, located at the end of the reservoir, is a mountain city. Prospecting tests conducted by the Huadong Surveying and Planning Institute have indicated that the city rests on stable bedrock with no geological faults that could create slippage of the banks once the reservoir begins to store water. In planning the storage water level, it has been estimated that the groundwater level will rise by only .32 to 1.41 meters to within 1.56 to 4.34 meters of the surface. This poses no threat of waterlogging. Although the normal reservoir storage level will be 8 meters above the natural dry season water level, the level for the city will rise by only .83 meters during the 20-year flood cycle. The majority opinion here is that the reservoir will result in enhanced flood control.

The building of the reservoir will result in the flooding of something over 30,000 mu of fields and the displacement of more than 50,000 people. Sixty-two kilometers of the Weiyang-Fuzhou Railroad will be under water as will be 100 kilometers of highway. Compared to other hydroelectric stations built throughout East China, the problem of flooded acreage and displaced population is not a big one. However, due to the pronounced imbalance in land and population in Fujian, it will mean added responsibilities and problems for the affected counties and cities. In this light, the conference urged careful consideration of the issues of land requisition and population displacement. To this end, it was proposed that special management and planning organs be created to coordinate and draft plans to relocate the populace, offering specific measures and budget estimates.

Spokesmen for the Provincial Planning Committee and the Provincial Hydropower Department stated that this environmental impact conference, the first held since the founding of the State, was a success and that it had been concluded that no serious threats to the environment would be created by the construction of the Shuikou Hydroelectric Power Station. As it had been determined that the advantages far outweigh the disadvantages, they urged that construction get under way at the earliest possible date.

CSO: 4013/279

## HYDROPOWER

### CONDITIONS SAID RIPE TO BEGIN CONSTRUCTION OF SHUIKOU HYDROPOWER PROJECT

Fuzhou FUJIAN RIBAO in Chinese 29 Jun 83 pp 1,4

[Text] At Shuikou, on the border between Minqing and Gutian, on the mainstream of the Min Jiang, Fujian Province will build the largest hydroelectric power station in the East China region. This news has been around for years and people have often written in asking about the progress of the project. To this end, on the 28th, a reporter of this paper interviewed responsible comrades of the Provincial Planning Committee on the subject of the construction of this station.

[Question] How will Fujian handle the strategic points of developing superiorities and energy resource construction?

[Answer] Fujian now has the capacity to supply only 5 billion kilowatt-hours of electric power and by the year 2000 the national income should be quadruple that of the 1980 base; the gap in electric power is enormous. The power supply of the entire East China region is also strained. Fujian's hydraulic resources are plentiful and under the guideline of "develop multiple energy resources," the first priority is placed on hydropower construction. Although Fujian's reserve of hydroelectric resources come to more than 7 million kilowatts, the largest in eastern China, only 20 percent or so of this has been developed. Fully developed and put to use, especially the fast construction of the Shuikou station, [this reserve] would serve not only to spur the province's economy, it would promote the economy of the entire East China Region as well.

[Question] We've heard that the arrangements for the construction of the Shuikou Hydroelectric Power Station have been made for years now. Can you fill us in a little bit on the status of the progress of the work?

[Answer] The Shuikou Hydroelectric Power Station is a big project. As far back as 1958 the Ministry of Electric Power started to conduct surveys and draw up plans. Later, they organized resources to carry out planning and studies to prepare a power station dam site. In September 1980, the Ministry met with the provincial government to go over the initial plans and published a report on the plan tasks. In 1982, the State Scientific and Technological Commission, in view of certain questions of particular interest to some comrades, specially organized related organs throughout the country and experts from all sectors to conduct technical and economic studies on this power station.

Foreign consultants and experts engaged by the World Bank also examined the relevant issues. They concluded that from the standpoint of the geological, transportation, and material considerations, Shuikou is a superb dam site well suited to the construction of a large-scale hydroelectric power station and is feasible both technically and economically. The relevant departments of the central authorities feel that now that the early phase of the work on the Shuikou Hydroelectric Power Station is proceeding smoothly and the stage is set for development, they hope that work will begin as soon as possible.

[Question] Just how big is the scale of construction for the Shuikou Hydropower Station? What will the benefits be when it is built?

[Answer] With an installed capacity of 1.4 million kilowatts, Shuikou will have good economic benefits. When built, it will ease the strained power consumption situation both in Fujian Province and the East China Region, especially in Shanghai; it will also play a vital role in dredging the Min Jiang and developing the shipping industry. The development of the Shuikou Hydropower Station, although principally for the generation of electric power, will also be a project that will benefit the comprehensive development of shipping. The power it will generate is the same as a million-kilowatt thermal power plant with its associated mine with a capacity of 2.5 million tons a year. After it has joined the East China Grid, it will transmit hundreds of thousands of kilowatts during peak load periods and will have a large seasonal capacity. It can also promote the economic benefits of joint thermal and hydraulic power.

[Question] It's been known for some time that certain comrades have expressed concern over such issues as the ecological balance, the flooding of land, and the displacement of the population. What's your view on these questions?

[Answer] Experts and scholars have reminded us to be aware of these problems when we build power stations; it is absolutely necessary, and shows our concern for national construction. Related departments and committees are also acutely aware of these views. The State Scientific and Technological Commission has organized central authority organs, committees, institutions of higher learning, and research departments to mount thoroughgoing studies into issues involving the impact the Shuikou Hydroelectric Power Station will have on shipping, aquaculture, agriculture, flooding, population displacement, silting, and hydrology and what changes it will mean for Nanping City. The consensus is that when the Shuikou Hydropower Station has been completed, it will have no serious effect on the environment. In general, the advantages far outweigh the disadvantages. The flooding of land and the displacement of population are problems commonly encountered whenever a medium-scale or large-scale hydroelectric station is being built. Comparatively speaking, the Shuikou Hydropower Station will involve the flooding of a fairly small amount of land and the displacement of only a few people. According to the investigation made by the East China Survey and Design Institute of the Ministry of Water Resources and Electric Power, the reservoir will displace 59,000 people; 30,000 mu of land will be flooded, the smallest loss of any provincial hydroelectric station constructed in South China. Land flooded for every million kilowatt-hours of electricity is only one-sixth that of the Gutian Xi Hydroelectric Power Station.

[Question] Some people are now saying that a nuclear power plant ought to be built instead of the Shuikou Hydropower Station. What are your views on this?

[Answer] We feel that this would be impossible in the near term. From the standpoint of energy development policies and near-term construction projects, the level of development and utilization of Fujian's hydraulic energy resources is still quite low. More hydropower must be used. The first stage work on Shuikou is going rather well, plans to relocate the populace and to reroute the railroad are already drafted, and preliminary use of foreign capital has been decided upon. The State's "Sixth Five-Year Plan" has been arranged and if construction is firmly grasped, the seventh and eighth five-year plans can be brought into full play. As a result, whether speaking of our province or all of eastern China, the Shuikou Hydroelectric Power Station should be built as soon as possible. Of course, speaking of our province, there are numerous harbors along the coast offering favorable building sites for nuclear power plants. We would welcome and cooperate with State ministries and commissions wishing to select nuclear plant sites in Fujian. The State, in its long-range planning, in addition to building three nuclear power plants in Guangdong, East China, and the Northeast, will continue to consider other nuclear power plant sites. Consequently, while Fujian builds the Shuikou power station, forces should be organized to conduct the early phase work of site selection for nuclear power plants and determine the economic and technological situation to create future conditions where there will be no conflict with building the Shuikou Hydroelectric Power Station.

[Question] From what you've presented, there's no doubt about the Shiukou Hydroelectric Power Station getting under way, is there?

[Answer] Right. It's the view held by responsible comrades of the central authorities that now that the early stage work on Shuikou has been satisfied, the conditions for development have been met and that we should get underway at the earliest possible moment. This is the biggest project in Fujian Province since the founding of the State; we will doubtless encounter all sorts of problems in building the project, but the people of Fujian are determined to reverse the backward state of their province and want to contribute to key state construction projects. There are construction personnel with considerable experience in building hydroelectric power stations; it only requires the close cooperation of the province's regions and departments along with all-out support from State ministries and commissions and the building of the Shuikou Hydroelectric Power Station is a sure thing.

CSO: 4013/299

## HYDROPOWER

### WORK ON SHAXIKOU HYDROELECTRIC POWER STATION GETS UNDER WAY

Fuzhou FUJIAN RIBAO in Chinese 27 Jun 83 p 1

[Article: "Work Begins on the Shaxikou Hydropower Station; Installed Capacity Is 300,000 Kilowatts, Exceeding That of the Four Gutian Xi Cascade Stations; Preparatory Work for Construction Now Being Stepped Up"]

[Text] A large-scale provincial construction project--the Shaxikou Hydroelectric Power Station--has been approved by the State Planning Commission and the provincial government and placed on the agenda. Work is now getting under way. Preparations for the construction work are now moving along. According to statistics as of 4 June, in the first 5 months of the year, the initial stage work was completed and investment accounted for 13 percent of the annual plan.

The Shaxikou Hydroelectric Power Station is located at the confluence of the Sha Xi and the Futun Xi, some 14 kilometers south of Pingshi. This daily regulatory, low-water-head hydropower station has a designed reservoir capacity of more than 164 million cubic meters and will have a total installed capacity of 300,000 kilowatts (four 75,000-kilowatt generators), exceeding that of the four Gutian Xi cascade stations. When finished, it will produce an average of 960 million kilowatt-hours of electricity a year. In addition to generating electricity, it will also benefit shipping. Early calculations show that construction investment will be 400 to 500 million yuan and construction time will require about 6 or 7 years. The State handed down the construction and planning directive for the Shaxikou Hydroelectric Power Station in 1980, and after the initial plans were examined and approved in 1981, all of the involved sectors immediately set about the first-stage construction work.

The East China Survey and Design Institute of the Ministry of Water Resources and Electric Power shouldered the task of designing the project. By the first of March, the Min Jiang Water Resources and Electric Power Agency, which is responsible for the major portion of the project, had arrived at the construction site, right on the frontline of command and production. Agency officials stated that [the problem of] land for the project had been partially settled and buildings and roads on the site were being rapidly constructed so that the Liyuzhou Bridge, which serves the dam construction, can begin to handle traffic. Looking at the situation as it stands now, there is still a lot of work to be done on the pre-construction preparations. What with the moving of people in

the reservoir area, the rebuilding of railroads, highways, and communications lines, the requisitioning of sand and gravel yards, etc. the task is awesome. If these problems are not resolved, it will be difficult for the main portion of the project to proceed. On the other hand, if the preparatory work goes along smoothly, construction could officially begin by the end of this year.

CSO: 4013/295

## HYDROPOWER

### JILIN AUTHORITIES ACT TO RESOLVE PROBLEMS PLAGUING BAISHAN

Beijing RENMIN RIBAO in Chinese 26 May 83 p 1

[Article by Zhang Shuzheng [1728 2579 2398]: Jilin Leadership Pushes Work on Baishan Hydropower Station]

[Text] First Secretary Qiang Xiaochu [1730 2556 0443] and Governor Zhao Xiu [6392 0208] of Jilin Province recently visited the construction site of the Baishan hydropower station to review the status of the construction project. At the site they held several meetings with local officials to solve a number of problems encountered during the construction.

The Baishan hydropower station is one of 70 key projects in this country; it is located on the Di'er Songhua Jiang bordering Huadian and Jingyu counties in Jilin Province. During the first 4 months of this year, the pace of construction had markedly picked up; the main problem was that the engineering facility for the station could not keep up. The original goal set by the State was to have two generators operating and one on reserve by the end of this year. However, on-site inspection showed that the two main generators did not meet specifications and had to be returned to the factory for modification. Qiang Xiaochu and Zhao Xiu thus took the action of sending a telegram to the Ministry of Water Resources and Electric Power, suggesting a meeting of concerned parties to discuss the important issues of certifying the equipment. In particular, they invited key personnel from the Ministry of Machine Building Industry and from the manufacturers to negotiate the terms of acceptance and delivery dates for this equipment.

Qiang and Zhao were also made aware of other problems such as the urgent need for 100 carpenters and 300 laborers at the construction site, the delay by certain government units in transporting 10,000 tons of coal to the construction site, the difficulty construction workers have in purchasing fresh produce and non-staple food, the inadequate supply of higher grade merchandise, and grievances on unfair supplemental pay to workers stationed in the mountain region. After meeting with Jilin City Committee Secretary Li Zhenjiang and Huadian County Committee Secretary Sun Jian, they took the following actions: the urgently needed carpenters and laborers would be hired from the local population, fresh produce would be provided by Huadian County; high grade merchandise would be supplied directly by secondary distribution centers in Jilin City, and the number of merchandise distribution points would be increased by both

city and county commerce departments. In addition, Li Zhengjiang telephoned the Jilin Railway Bureau to resolve the problem of delays in coal shipment. He also requested an immediate investigation of the supplemental pay problem by the Jilin Labor Bureau and a reasonable solution of the problem after the investigation. After Qiang Xiaochu and Zhao Xiu returned to Changchun, they appointed a planning committee to establish a "service group to provide assistance on key issues" as part of the provincial government. Members of the group have already arrived at the site to carry on their work.

3012

CSO: 4013/237

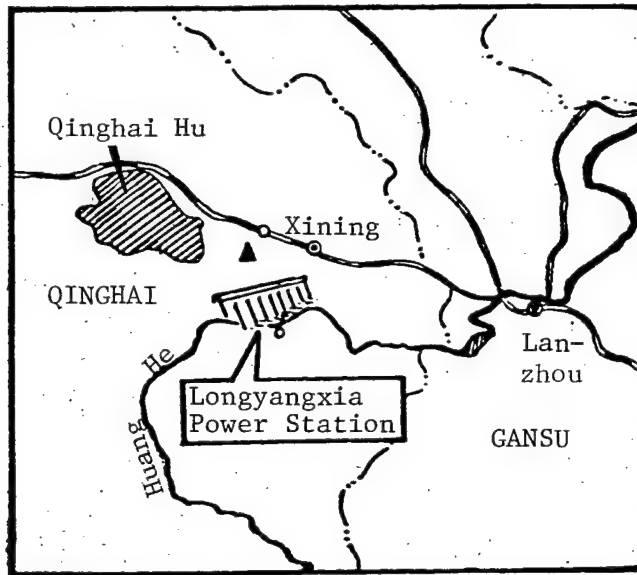
## HYDROPOWER

### LONGYANGXIA WILL BE NATION'S FIRST IN DAM HEIGHT, RESERVOIR AREA

Beijing RENMIN RIBAO in Chinese 16 Jul 83 p 3

[Excerpts] Longyangxia is located in the Hainan Zangzu Autonomous Prefecture, 140 kilometers from Xining City. It is the first cascade hydroelectric power station on the upper reaches of the Huang He. The dam has a designed height of 177 meters, the highest in China to date. After it is built, it will create the largest man-made lake in the nation. The lake will have a surface area of 393 square kilometers and a total reservoir capacity of 26.8 billion cubic meters; the hydroelectric power station will have a total installed capacity of 1,280 megawatts for a yearly power output of 6 billion kilowatt-hours.

After this hydroelectric power station has been built, it will play a major role in the development of the Huang He's hydraulic resources and in accelerating construction in the northwest. First, it will provide more electricity for the Shaanxi-Gansu-Qinghai Grid and then, by regulating the volume of water, enable the four hydropower stations of Liujiaxia, Yanguoxia, Bapanxia, and Qingtongxia to increase their yearly output by 640 million kilowatt-hours. Next, after it joins Liujiaxia in operation, it will provide an additional 14.91 million mu of irrigated land in the Huang He River Valley below it as well as an additional 6.5 billion cubic meters of water for irrigation and 470 million cubic meters of water for municipal industries.



Map showing location of the  
Longyangxia Hydropower Station.

CSO: 4013/277

## HYDROPOWER

### BAISHAN NOW HAS MINIMUM WATERHEAD FOR GENERATING POWER

Beijing RENMIN RIBAO in Chinese 23 May 83 p 2

[Article by XINHUA reporters Niu Zhengwu [3662 2973 2976], Chen Guangjun [7115 1684 0193], and Yu YingRui [7411 3841 3843]]

[Text] The dam of the Baishan Hydroelectric Power Station below Changbai Shan on the upper reaches of the Songhua Jiang is 670 meters long, 149.5 meters high, and has a storage capacity of 6.8 billion cubic meters. The dam has now been poured to a height of 110 meters, and stored 1.2 billion cubic meters of water, the minimum water level for initial power generation. Projects such as the main machinery building, the central control room, the transformer room, the air conditioning room and switching station are in the process of interior outfitting and equipment installation.

The sixth largest river in China, the Songhua Jiang has hydraulic resources capable of generating up to 5,900,000 kilowatts. The Fengman Power Station was the first station built to use the hydraulic resources of the Songhua Jiang. The Baishan Hydroelectric Power Station is situated 250 kilometers upstream from the Fengman Hydroelectric Power Station, and is another large-scale key water conservancy project to be built on the Songhua Jiang. These two large-scale power stations, and the Hongshi Power Station now being built between them, will constitute the cascade development of the upper reaches of the Songhua Jiang. Total installed capacity can reach 2,560,000 kilowatts.

The Baishan Hydroelectric Power Station is one of 70 key projects now being built in China. It is also the largest hydroelectric power station in the northeast. Its installed capacity is 1,500,000 kilowatts. Each project has two stages. The installed capacity of the first stage is 900,000 kilowatts, and that of the second is 600,000 kilowatts. The main and auxiliary buildings of the first stage of the project are set up completely in caves. The main building is 54 meters high, corresponding to an 18-story building. Three 300,000-kilowatt Chinese-made hydraulic turbine generators will be installed here.

The Baishan Hydroelectric Power Station is a large-scale, key power station designed mainly to generate power but has comprehensive benefits such as flood control, ice flow reduction, and aquaculture. After the first stage

of the project is finished, it will be able to provide 2 billion kilowatt-hours of electric power yearly for the northeast region. As to easing the present tight supply of electric power in this region, it will maintain voltage stability in the northeast grid, and play an important role in promoting economic growth in the three provinces of Jilin, Liaoning, and Heilongjiang. At the same time, due to the regulatory reservoir formed by the dam of the power station, the persistent great floods that have been encountered for 200 years can be prevented, and downstream ice and spring floods can be safely weathered.

12310

CSO: 4013/238

## HYDROPOWER

### 20,000 CONSTRUCTION WORKERS MASSED FOR ONSLAUGHT ON TIANSHENGQIAO

Beijing RENMIN RIBAO in Chinese 9 Jun 83 p 4

/Excerpts/ On the Nanpan Jiang, on the border between Guizhou and Guangxi provinces, a large-scale hydropower station--the Tianshengqiao Hydroelectric Power Station--is now under an accelerated construction schedule. Some 20,000 construction workers have massed for a great battle to be waged over more than 60 square kilometers in the rugged countryside on both sides of the river.

Rich in hydraulic resources, the Nanpan Jiang twists and turns for more than 900 kilometers in a rushing torrent. There are tremendous advantages in building hydroelectric power stations here.

The Tianshengqiao Hydroelectric Power Station has a designed installed capacity of 2.4 million kilowatts and a yearly output of 13.5 billion kilowatt-hours, only a little less than that of the celebrated Gezhouba Hydroelectric Power Station. The overall hydroelectric complex consists of a high dam and a low dam. Preparatory work for the construction of the low dam began in April 1982 and the first generator will become officially operational in 1990. The high dam is now in the survey and design stage. Work will begin on it after 1985.

After the Tianshengqiao hydroelectric power stations have been completed, the yearly power output will be equal to one-and-one-half times the total 1980 hydropower capacity for the three provinces of Guizhou, Guangxi, and Guangdong. At that time, the huge amount of electricity being generated by Tianshengqiao will be transmitted via 500KV high-tension power lines into the southwest and Guangxi power grids, as well Guangdong, forming an "east-to-west" basic pattern.

CSO: 4013/264

## HYDROPOWER

### PREPARATIONS BEING MADE TO POUR MAIN DAM OF DONGJIANG POWER STATION

Shanghai JIEFANG RIBAO in Chinese 1 Jun 83 p 3

/Text/ Excavation work on the foundations of the main dam of the Dongjiang Hydroelectric Power Station, the largest of its kind in Hunan Province, is nearing completion. Construction workers are now preparing to pour concrete for the highest double-arch dam of any hydroelectric power station now under construction in China. After the dam is completed, the reservoir will store 8.1 billion cubic meters of water, the largest such reservoir of any hydropower station in the province.

The Dongjiang Hydroelectric Power Station is located in a gorge near the town of Dongjiang in Zixing County on the upper course of a tributary of the Xiang Jiang in southern Hunan. In terms of hydraulic resources, it is the best of any of the tributaries of the Xiang Jiang and is a key river for the hydropower development of the Xiang Jiang River Valley.

According to plans, the Dongjiang Hydroelectric Power Station will have four generators with a total installed capacity of 500,000 kilowatts. The first unit is expected to begin producing electricity in 1986. After the entire power station has been built, it will generate 1.32 billion kilowatt-hours of electricity a year. In order to regulate the volume of flow and to guarantee a balanced supply of water for downstream industrial and agricultural production, the "Little Dongjiang Hydroelectric Power Station" will be built 9 kilometers below the main station.

Today, Hunan Province has 7.5 million kilowatts of hydroelectric output to feed into the grid but dry season capacity is only one-third this amount. The special feature of the Dongjiang Hydroelectric Power Station is that it will have multiple-year regulatory capability. Because its reservoir capacity is so large, it can store more water during the rainy season and then generate more electricity during the dry season. During years of drought, it can use the water stored up over the years to generate power. The electricity it will generate will be transmitted through three 220KV high-tension power lines into the Hunan grid, playing a decisive role in regulating and supplementing power in the grid and improving greatly the situation of power shortages in Hunan during the dry season.

The Dongjiang Hydroelectric Power Station will also play a part in flood control, shipping, and aquaculture, as well as supplying water to industry and agriculture.

## HYDROPOWER

### ECONOMICS OF HYDROPOWER DEVELOPMENT EXPLORED

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 5, 12 May 83 pp 3-4

[Article by Zhang Guangdou [1728 0342 2435] of Qinghua University: "Some Views on Accelerating Hydropower Development"]

[Text] The author was extremely encouraged by reading the interview of Minister Qian Zhengying [6929 2973 5391] in SHUILI FADIAN where the goal of quadrupling hydropower production in 20 years was clearly spelled out. A current popular conviction is that hydropower requires more investment and construction time than coal power, but this is in fact not true. For hydropower, the cost per kilowatt-hour (kWh) is approximately 1,300 to 1,500 yuan and a large or medium hydropower station takes 5 to 10 years to build. For power production by burning coal, the cost per kWh is approximately 600 yuan, plus 300 to 400 yuan/kWh, which is comparable to that of hydropower. The construction time for coal mines and railroads is also about 5 to 10 years. In comparing the economy of hydropower and coal power, the total investment was used for hydropower while only the coal-fired power plant investment was counted and the investments in coal mines and railroads were not counted; that is obviously unreasonable. In addition, the price of coal today is too low and is subsidized by the state. In an economic comparison a realistic coal price should be used and the construction time for coal mines and railroads should also be taken into account. Only then can we correct the misconception of some people and speed up the development of hydropower.

A major difficulty in developing hydropower is the reservoir flooding loss. The current reservoir flood compensation is too high and is getting higher. One should really look at the economics here; how much agricultural production increase there will be after the hydropower station is built, and how much production loss there will be after the flooding. Excessively high compensation is unfavorable to hydropower development. Flood compensation should therefore be reasonable and increases in agricultural output value should also be taken into account fully so that the development of hydropower may proceed smoothly.

Another problem we should look at is the distribution of hydropower investment. The construction of a hydropower station generally provides such benefits as flood prevention, irrigation, water supply and shipping. In our current plans for hydropower construction, the entire investment cost is often put under hydropower development. This is not only unreasonable, it also tends to encourage others to make excessive demands and the result is the overall

investment and cost are increased, which is detrimental to the development of hydropower. Instead, investment in hydropower construction should be shared and the economic accounting should take into account the benefits of flood prevention, irrigation, water supply, and shipping. If the requirement in a certain area is too high and becomes economically unfeasible, then it should be lowered, or some room for expansion should be provided for the future. In any case, not all the expenditures should be put under the hydropower category. If national policy states that a certain investment should be supplemented by the state, it should be so stated clearly.

The key to accelerating hydropower development and to improving the economic efficiency of hydropower is in the planning. China has made considerable achievements in hydropower, and planning should receive some credit. But hydropower planning is very complicated and further refinements are called for. First we should strengthen the survey effort, not only determining natural conditions such as the need and utilization of hydropower, land use, the economic status of the people and social and economic impact of the hydropower construction. Hydropower economics is an important field and is closely related to water conservancy and transportation. Conducting sound planning requires both specialists in water energy calculation and systems engineering, and knowledgeable and experienced scientific and technological personnel in position of authority.

Construction is a crucial step in hydropower development. Today we have an experienced construction force of some 200,000 people who are the primary force for hydropower construction today and the future. But undeniably, the present construction quality is less than desirable, in some cases even worse than that of the 1950's. Construction efficiency is also low and there is considerable waste. To speed up hydropower development, substantial improvements must be made in the area of construction. There are potential benefits in construction research and great benefits can be derived from many projects. Neglected in the past, it should be greatly strengthened in the future. In addition, construction quality inspection should be the responsibility of design departments--a common practice in many countries--to insure good engineering quality. The situation in the Soviet Union is also moving in this direction.

In the interview, Minister Qian proposed four strategic measures which are all very important. We wish to add one more item regarding the training of the engineering and technical staff. The advancement of hydropower relies on the progress in science and technology, and the advancement and promotion of science and technology requires technical personnel. New technical staff in various specialties and at various levels should be trained and the training of skilled workers is also very important. Training should be provided for the existing technical staff as well. The distribution of technical talent in hydropower engineering is usually a pyramid, with a small number of advanced people on top and many at the bottom. In foreign countries the ratio is one college graduate to one vocational high school graduate, three to four graduates of secondary vocational school and more than 10 technical school graduates. The current ratio in China is one college graduate to one secondary vocational school graduate and very few technical school graduates. This is very irrational and the situation must be rectified by greatly increasing the number of secondary vocational schools and technical schools. In the future, training and research in

institutes of higher learning should face the needs of hydropower construction. On behalf of Qinghua University, I sincerely express our willingness to serve hydropower development in our teaching and research. We shall strive to make contributions and would like to have the guidance and assistance of the Ministry of Water Resources and Electric Power.

9698

CSO: 4013/234

## HYDROPOWER

### SITES PROPOSED FOR EXPERIMENTAL RIVER DAMMING BY NEW DETONATION TECHNOLOGY

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 1, 12 Jan 83 pp 48-50

[Article by Feng Baoxing [7458 1405 5281], Jin Yongtang [6855 3057 1016], Wang Baoyi [3769 5508 3085], and Yang Renguang [2799 0086 0342]]

[Excerpts] China has many rich water power resources with the unique feature that 80 percent of these resources is contained in deep-gorge rivers. The advantage of these rivers is that they have abundant volume of water and concentrated elevation drops; however, the disadvantage is that it is not feasible to use conventional methods for dam construction in these regions because of the high mountains, narrow gorges, rapids, and difficult transportation problems. A key to developing these rich water power resources is to find a method which is suitable for the conditions of deep-gorge rivers. The late Comrade Zhang Chong, who was vice chairman of the National Political Association, had spent many years studying the problem, and had proposed an idea to construct large-scale hydropower stations by using the method of directional detonation to create rock dams across the gorges without applying sealing materials.

Zhang Chong's concept was based on his observation of natural rock dams in the southwestern part of the country, and the progress being made by China's engineering community in the rapidly advancing detonation technology. On a deep-gorge river, the river bed is narrow with tall mountains rising along its banks; these conditions are unfavorable for flow diversion or for establishing construction sites. However, for directional detonation, these are favorable conditions. The procedures of using directional detonation for dam construction are as follows: first, a tunnel is drilled through the mountains on one or both sides of the river, and caves for holding the explosives are excavated in the area near the top of the mountain, in accordance with the detonation plan; once the explosives are in place and detonated, a dam is created almost instantly, and water from the blocked river is guided downstream through the tunnels. This method of dam construction does not require building dikes for shielding the construction site; it does not require clearing the foundation, or building flow diversion tunnels; neither does it require large quantities of concrete, heavy machinery, or a great amount of labor for preparation work. It avoids the difficulties of setting up the construction site, and also avoids the problem of shielding the construction from potential floods during high-water season. In short, the complicated dam construction process is simplified to just two main tasks: drilling tunnels, and detonation of explosives. This is the first advantage of Zhang Chong's concept.

The second advantage of Zhang Chong's concept is the large savings in investment. To build a rock dam by manual labor would cost over 20 yuan per each square meter; building a concrete dam would cost over 50 yuan per square meter; however, by using the method of directional detonation, each square meter costs only about 2 yuan. Although a rock dam built by directional detonation has a gradual slope and relatively large volume, still a saving of one-third to one-half in total investment can be achieved. According to comparisons made by the Soviet Union between rock dams built in the 70's using detonation methods and conventional earth and rock dams, it was found that the taller the dam, the more pronounced the economic advantage of the detonation method: by increasing the dam height from 60 m to 370 m, the investment in the dam was reduced to only 50-15.4 percent of the original, and the overall investment was correspondingly reduced by 8-45 percent. If it is not necessary to apply sealing materials to the foundation and the dam body, additional savings can be achieved.

The third advantage of Zhang Chong's concept is that the construction time can be greatly reduced. Since the dam is created instantly after the explosion, it is not necessary to apply sealing materials, to clear the foundation, or to construct shielding dikes. It is only necessary to prepare the holes for inserting the explosives, and to arrange the dam surface. By reducing the construction time, the water reservoir can be constructed and put into use rapidly, increasing economic efficiency.

The fourth advantage of Zhang Chong's concept is the increased safety of this type of dam against air attacks and earthquakes. Because of its lower cost, rock dams can have thicker bodies, and the loose-pellet structure is safer than other types of dam structures.

In view of these advantages, early implementation of Zhang Chong's ideas will have strategic importance in accelerating the development of China's southwestern water power resources and in solving the energy problem for the four modernizations program. To illustrate these ideas, we shall consider the Jinsha Jiang as an example.

The Hutiaoxia, located in the upper reaches of Jinsha Jiang has a gorge section 17 km long and a concentrated elevation drop of 200 m. The narrowest part of the river is 40 m, and the widest part is approximately 100 m. The initial plan is to develop the upper and lower gorges in two steps. The upper gorge is approximately 1,800 m above sea level, and its average yearly volume is 42.2 billion  $\text{m}^3$ . It has Yulongxue Shan on the right side of the river and Habaxue Shan on the left. The mountains are over 1,000 m above the water surface, with a slope of 55 degrees. Experience indicates that a slope of 40 degrees provides desirable conditions for directional detonation; therefore, by detonating from both sides of the river, a dam 291 m in height can be created. The slope upstream would be 1:3, and the slope downstream would be 1:6; the total volume of dirt and rocks required is 52 million  $\text{m}^3$ , and the amount of explosives required is 52,000 tons. Once the dam is created, it can store 46.7 billion  $\text{m}^3$  of water in the reservoir at a water level of 241 m; the total tillable land to be flooded is only 10,000 mou, and 10,000 residents are to be relocated. Hutiaoxia is located on the upper reaches of the Jinsha

Jiang; its water supply primarily comes from melting snow, hence the flow rate does not vary a great deal from year to year. Reservoirs with water levels less than 201 m are used for power generation and water storage; those with water levels between 201 m and 241 m are used for water regulation and flood prevention. The average flow rate of the upper gorge is  $1,338 \text{ m}^3/\text{sec}$ ; in the case of a 10,000-year flood, the maximum flow rate after flood regulation by the reservoir is  $3,850 \text{ m}^3/\text{sec}$ . In order to ensure dam safety and maximum utilization of the water power, the maximum flow rate is used as the criterion for designing four 14.5-m diameter tunnels to direct the water for power generation. Since this meets the flood-prevention requirement for the dam, additional flood prevention structures will not be necessary or can be greatly simplified. A total generating capacity of 6 million kw will be installed, with an annual operating time of 3,040 hours. The guaranteed production will be 2 million kw, and the annual power output can reach 18.2 billion kilowatt-hours. The water surface of the lower gorge of Hutiaoxia is approximately 1,600 m above seal-level; on the left shore is a plateau 230 m above the water surface, on the right shore is a cliff rising at a slope of 70 more than 1,000 m above the water surface. By detonating 12,000 tons of explosives on the right side a 12 million- $\text{m}^3$  dam can be created whose height will exceed 200 m. The lower gorge reservoir can operate in parallel with the upper gorge reservoir; it can also accommodate a generating capacity of 6 million kw, with guaranteed production of 2 million kw, and annual electricity output of 18.2 billion kilowatt-hours. The combined output of the upper and lower gorges is 36.4 billion kilowatt-hours, the equivalent of 12 percent of China's total output in 1981. In straight-line distance, Hutiaoxia is 168 km from Dukou, 220 km from Xichang, 348 km from Kunming 468 km from Yibin, 540 km from Chengdu, and 668 km from Chong Qing. All of these cities are located within the range of the 500,000 volt ultra-high voltage transmission lines. Between Hutiaoxia's lower gorge and Yibin, there is over 1,300 m of usable elevation drop. Along the 1,200-km section of the river between the lower gorge and Yibin, there are many gorges such as Baoshanxia, Leishitan, Wudongde, and Jingangxia, which are all suitable for dam construction by directional detonation.

The cascade development of the Jinsha Jiang will eventually provide 60 million kw of generating capacity, and an annual output of 300 billion kilowatt-hours which is equivalent to China's total electricity output in 1981. The total tillable land to be flooded is only 390,000 mou, and the number of residents to be relocated will be around 200,000. In conjunction with the development of hydropower will be the development and utilization of mineral resources along the banks of the Jinsha Jiang such as iron, vanadium, lead, titanium, zinc, copper, tungsten, cobalt, and the 700 million  $\text{m}^3$  of lumber contained in 180,000  $\text{km}^2$  of forestland. However, some comrades are skeptical about using directional detonation for dam construction. They have two main concerns: First, they wonder if the dam will be sufficiently stable without being treated for infiltration, and if the dam may collapse due to the phenomenon of "tunneling" (i.e., removal of fine particles from the dam body and foundation by water). Second, they question if there will be excessive leaks from the rock dam to adversely affect water storage.

To answer these two questions, let us look at some facts from nature and from actual project experience.

On 25 August 1933, a strong earthquake (7.4 on the Richter scale) took place near Diexicheng in the upper reaches of the Min Jiang. During the earthquake, a mountain collapsed, burying Diexicheng underneath. The collapse blocked the flow of the Min Jiang and created two natural rock dams 130-150 m in height, and two natural reservoirs. The foundations and main bodies of these two dams have never been treated for infiltration, but despite many years of flooding, the dam structures have stabilized. The larger dam, called Dahaizai, has a storage capacity of 80 million  $\text{m}^3$ ; the smaller dam is called Xiaohaizi, and has a storage capacity of 50 million  $\text{m}^3$ . In addition, in Leibo County, Sichuan Province, there is a natural dam at Mahu which is 70 m tall and normally stores 300-400 million  $\text{m}^3$  of water. Since ancient times the dam has been subjected to many earthquakes, but it still stands firm today.

In terms of actual project experience, the Shibiangu reservoir in Shanxi Province maintained a water level of 40 m before the rock dam was treated for infiltration, and the dam structure remained stable. In Yunnan Province, the Kangjiahe reservoir in Yongsheng County stored water at a level of 28 m without having the rock dam treated for infiltration, and the dam structure also remained stable.

The question of infiltration stability has also been addressed by theoretical research with definite results. Comrades at the Water Conservancy and Hydro-electric Institute have analyzed the materials of directional detonation from this country and from the Soviet Union, and conducted tests in the laboratory. In their opinion, the infiltration stability of a rock dam body is primarily determined by the consistency and density of the particles. If the density of dry particles is great than 1.8 tons/ $\text{m}^3$ , and the particles are properly arranged in size, then even though leaks exist, the fine particles will not be washed away; under these conditions, the dam will remain stable despite infiltration. They have analyzed statistical data of excavated samples and surface particles from the Bailong detonation dam of Jiangchuan County, Yunnan Province, the (Bu'erleike) experimental dam in the Soviet Union, the Nanshui dam in Guangdong Province, and the Shibiangu dam in Shanxi Province, and concluded that the particles in detonation dams have good consistency and are densely packed (dry density 2.0-2.3 tons/ $\text{m}^3$ ). Therefore, infiltration stability of detonation rock dams is a rule rather an exception.

With regard to the question of whether normal water storage will be affected by excessive leakage, let us also find the answer by reviewing some facts. The natural reservoirs referred to earlier, Dahaizi, Xiaohaizi, and Mahu, always maintain full capacity. The Shibiangu reservoir which was created by directional detonation allowed only 0.7  $\text{m}^3/\text{sec}$  leakage at a water level of 40 m before it was treated for infiltration. The Kangjiahe reservoir allowed only 0.2  $\text{m}^3/\text{sec}$  leakage downstream at a water level of 28 m before it was treated for infiltration. Most dams created by earthquakes or directional detonation have proved to be densely packed, with very little leakage; hence, their water storage capacity will not be affected if it is supplied by a large or medium size river. It is also observed that the sediment in the water tends to fill gaps in the dam structure, thus serving as a natural seal against infiltration. For example, at the (Bayibosike) dam in the Soviet Union, under the action of a 50-m water head, the amount of leakage was reduced to one-fifth

to one-tenth to sediment deposits. Furthermore, modern detonation techniques allow taking special measures prior to detonation; for example, the use of planar detonation can produce a clay wall on the upstream surface of the dam; or, by using special placement of the explosives, it is possible to form a region at the enter of the dam with fine particles, good consistency, and small gaps in order to minimize leakage. In short, by the use of proper detonation techniques, the amount of leakage can be controlled to ensure normal water storage. If necessary, the reservoir can be treated for infiltration after a certain period of use. For instance, one can throw crushed stone or clay onto the surface facing the water flow or apply sealing material to the dam body above the dead water level and build a concrete wall below the dead water level, or inject sealing materials into the fine particle region at the center of the dam body to form a screen against infiltration. These methods have all been used in practice and have proved to be effective.

In 1963, the detonation dam at Dongchuankou in Hebei Province was destroyed by floods because the flood relief channel was too narrow, but this does not invalidate the detonation method for dam construction. In deep-gorge rivers, because of the favorable terrain, relatively small flood losses, and low cost, the method of directional detonation can be effectively used to construct tall dams and large reservoirs which have sufficient capacity to regulate draught and flood conditions. During high water season, the reservoir can store a large volume of flood water which not only ensures the safety of the dam structure but also reduces or eliminates the threat of flood damage downstream.

Although we have constructed over 50 rock dams on small rivers using the method of directional detonation, these experiences are not adequate for large rivers. In addition to the theoretical research and laboratory tests, we must gain practical experience by conducting actual intermediate tests. On the basis of preliminary investigations, we propose the following dam sites as targets for the intermediate tests.

One is the Dengzishan gorge located on the Pudu He, which is a branch of Jinsha Jiang. The other is the Tianhuaban gorge located on the Niulan Jiang, also a branch of the Jinsha Jiang. Both of these dam sites have the following common features: 1) they satisfy the conditions for intermediate tests; 2) they have small flood losses, hence high economic pay-off; 3) the regions downstream are sparsely populated, hence the tests pose no threat to these regions. The Dengzishan gorge is 1.5 km long, and has an average yearly volume of 2.5 billion  $m^3$ ; the maximum gross water head is 160 m, with a potential generating capacity of 130,000 kw. The shores rise 500-600 m above the water surface, and have a slope of  $60^\circ$ - $70^\circ$ . Preliminary design plan indicates that 7,500 tons of explosives are required, and 7.14 million  $m^3$  of rock and earth are to be detonated to create a dam with a water head of 150 m. The Tianhuaban gorge is approximately 3 km long, and has a yearly volume of 5 billion  $m^3$ ; the maximum gross water head is 180 m, with a potential generating capacity of 300,000 kw. The two banks rise 800 m above the water surface, with an average slope of  $70^\circ$ . Preliminary designs indicate that 10,000 tons of explosives are required to construct a dam with a water head of 150 m. Completion of one of these 150-m dam projects will provide us with valuable experience to build a 200-m dam. We will then be ready to tackle the Hutiaoxia project on the Jinsha Jiang.

## HYDROPOWER

### HYDROPOWER GENERATES 73 BILLION KILOWATT-HOURS OF ELECTRICITY IN 1982

Beijing HUILI FADIAN [WATER POWER] in Chinese No 2, 12 Feb 83 p 7

[Article by Li Bijun [2651 1084 0689]: "Hydroelectric Power Generates 73 Billion Kilowatt-hours of Electricity in 1982, an Increase of 12 Percent Over 1981"]

[Text] In 1982, the nation's hydroelectric power generated 73 billion kilowatt-hours of electricity, constituting 22 percent of the national output, and registering an increase of 12 percent over 1981. An output of 73 billion kilowatt-hours of electricity is equivalent to replacing more than 29,200,000 tons of standard coal or 43,800,000 tons of raw coal.

Among the nation's major power grids, the Central China Power Grid generated the most hydroelectricity. Its output of hydroelectricity was 10.4 billion kilowatt-hours. This was followed by the Northwest Power Grid, with an output of 9.4 billion kilowatt-hours. The Hunan and Sichuan power grids both surpassed 5 billion kilowatt-hours in output.

The Gezhouba Hydroelectric Power Station of the Central China Power Grid generated 3.3 billion kilowatt-hours more electricity than 1981 due to more abundant incoming water. The Liujiaxia Power Station of the Northwest Power Grid generated 5.5 billion kilowatt-hours of electricity in 1982, creating the best level in history. The three power plants of Liujiaxia, Yanguoxia, and Bapanxia generated a total of 8.5 billion kilowatt-hours. Because the Northwest Power Administrative Bureau placed a lot of emphasis on leading the power grids to generate and use more hydroelectricity, the dispatching departments of the power grid made detailed arrangements during the period of maximum generation of hydroelectric power by personal on-site inspections and by allowing dispatching personnel to discuss operating methods that were favorable to the safety, economy, and coal conservation of the power grid. Hydroelectric power and thermoelectric power were closely coordinated. The efforts enabled the whole grid to generate 900 million kilowatt-hours more electricity over 1981 and conserved 360,000 tons of standard coal. The incoming water at the Zhexi and Fengtan hydroelectric power stations in Hunan was medium-abundant. Distribution within the year was even. The dispatching department conscientiously analyzed water conditions and conscientiously arranged and readjusted the operating method. Throughout the year, the two stations generated a total of 4.6 billion kilowatt-hours, constituting 83.6 percent of the 5.5 billion kilowatt-hours of electricity generated by hydroelectric power plants directly

subordinate to the power grid throughout the year and reaching the highest level in history. The incoming water at the hydroelectric power station in Sichuan Province was medium. The dispatching department carefully dispatched electric power and used hydroelectricity and thermoelectricity to supplement each other according to the plan for optimized dispatching of the group of reservoirs of the hydroelectric power and whose reservoirs have a poor regulatory function. This increased the output of hydroelectricity of the entire power grid by 450 million kilowatt-hours over 1981, which was a year of medium-abundant incoming water. At year's end, the water level of the Shizitan Reservoir was 1 meter higher than that in 1981. The incoming water at the hydroelectric power stations of the East China and the Northeast power grids was slightly less, and with the extra amount of electricity dispatched during the previous period, the water level of the reservoir rapidly dropped. The East China Power Grid exercised stricter control. Throughout the entire year, the amount of hydroelectricity generated was close to that in 1981. The amount of water stored in the reservoir was about the same as that in 1981. But the amount of hydroelectricity generated by the Northeast Power Grid was 1.57 billion kilowatt-hours less than that in 1981, which was a year of medium-abundant incoming water. The amount of water stored in the reservoir was less than that in 1981.

In 1982, the achievement of the nation's output of hydroelectric power was great. In the new year, we must exert more efforts to improve the level of management of dispatching and fully develop the benefits from hydroelectricity.

9296

CSO: 4013/158

## HYDROPOWER

### BRIEFS

LARGEST LOW-HEAD STATION GENERATES POWER--On 1 June, the No. generator of the nation's largest low-head, flow-through power station--the Majitang hydropower station--officially began to generate electricity. The No. 2 and No. 3 generators are now being tested. The Majitang Hydroelectric Power Station is located on the lower reaches of the Zi Shui in southern Hunan Province. The three generators have a total installed capacity of 55,500 kilowatts and will produce 270 million kilowatt-hours of electricity a year. [Text] [Kunming YUNNAN RIBAO in Chinese 20 Jun 83 p 4]

CSO: 4013/295

## THERMAL POWER

### OTHER PROJECTS SIDELINED TO RUSH COMPLETION OF TAIZHOU POWER PLANT

Hangzhou ZHEJIANG RIBAO in Chinese 19 May 83 p 1

/Excerpts/ At the National Symposium on Experiences in Building Thermal Power Projects held recently in Huaibei, some experts praised the rapid construction, the high quality, and the early benefits from the Taizhou Power Plant, a key national construction project. This is the direct result of the vigorous support given by Taizhou itself out of concern for the overall situation.

At the project's outset, 1 million cubic meters of rock had to be removed to excavate the foundations. Such a large amount of work required 3 years at Zhenhai, where machinery was used. Eager to support this key national project, the Prefecture CPC Committee mustered several thousand civilian workers and created favorable conditions so that only a year's time would be required to dump 1 million cubic meters of rock into the sea. Such rapidity in building foundations is unprecedented in the province. Expenses required at the time to put in roads, power, and water were advanced out of the prefecture's public funds. The large amounts of explosives and detonators needed to cut the mountain away and drill rock were funded in advance by individual counties. Tractors needed by the civilian workers to move rock were supplied through allocations from the prefecture's material quotas.

During the last half of 1981, as a result of a need to transfer a portion of forces to construction at Zhenhai by the Zhejiang No 2 Construction Company, which was responsible for earth work at the Taizhou Power Plant, the remaining construction force seemed inadequate. At this point, Linhai, Jiaojiang, Wenling, Xianju, and Huanyang counties put their own interests aside and delayed construction of more than 100 local capital construction projects. Construction committee personnel in charge in each county (or municipality) took the lead in organizing construction corps, in making new purchases of construction equipment, and in advancing funds for construction materials to undertake the highly difficult construction tasks that had not yet been undertaken of building at the Taizhou Power Plant a 220,000-kilovolt and a 110,000-kilovolt booster station, a grid control building, underground conduits, and a coal loading bridge. This meant that the building of main structures and complementary facilities would be done at the same time to help shorten the total construction time.

The requisitioning of land during the early stage of the project posed difficulties such as have been generally encountered in recent years in capital

construction. Some places took the opportunity to work a racket, making unreasonable demands. The Taizhou Prefecture CPC Committee and government leaders focused on overall benefits and promptly handled matters properly. The problems of jobs for 300 rural laborers caused by the requisitioning of land for the Taizhou Power Plant was solved at the initiative of the prefecture without burdening the Taizhou Power Plant with the placement of the rural manpower. By the end of 1982, more than 90 percent of the 340 communes in the prefecture had electricity, and it is anticipated that every commune will have electricity this year. Civilian electricity bills in each county in the prefecture dropped tremendously. Since the Taizhou Power Plant began generating electricity, urban and town residents have received several hundred million yuan worth of direct benefits. Four chemical fertilizer plants that formerly had to shut down routinely now receive a regular supply of electricity and their output has shot up 50 percent. As of the present time, the Taizhou Power Plant has supplied 280 million kilowatt-hours of electricity.

9432

CSO: 4013/256

## COAL

### COAL INDUSTRY MAPS ITS COURSE FOR YEAR 2000

Beijing SHIJIE MEITAN JISHU [WORLD COAL TECHNOLOGY] in Chinese No 5, 1983 pp 2-6

[Article by Wnag Senhao [3769 2773 3185], Deputy Secretary of Shandong Province Party Committee and foremr Chief Engineer of Ministry of the Coal Industry: "Some Preleiminary Conceptions of Technical Progress in China's Coal Industry During the Next 18 Years"]

[Text] The 12th Party Congress stated that "The shortage of energy and transportation constitutes a major factor restricting China's economic development today." Coal is our country's main energy source, and for a relatively long period it will account for more than 70 percent of our primary energy sources; the figure is expected to reach 76-78 percent by the end of the century.

In order to assure victorious accomplishments of the party's grand goals, we must do everything possible to upgrade the coal industry, and, while increasing economic results and promoting energy conservation in society, we must double coal industry output to assure quadrupling of national output value. This means that in the 20 years between 1981 and the end of the century, we must strive to bring nationwide raw coal output up from about 600 million tons a year to 1,200 million tons a year, improve quality, increase the number of varieties, expand coal processing and utilization, create the conditions for energy conservation in society, adapt to the development needs of the national economy and assure that gross national output value will quadruple.

As China's major energy supplier, the coal industry must expand; as Premier Zhao Ziyang stated at the National Scientific and Technical Awards Conference, "To vigorously develop the economy and quadruple output, we must rely on scientific and technical progress, for it is impossible to quadruple output on the basis of old technology, old equipment, old materials, old processes and old products, and with the technical and economic indices that we have already achieved." If we do not rely on scientific progress it will be impossible to accomplish the strategic task of doubling coal output in support of quadrupling of national output value. Therefore, tachtical progress is a major strategic policy for the coal industry.

## THERMAL POWER

### THIRD PHASE OF DOUHE POWER PLANT PROJECT NOW TAKING SHAPE

Shijiazhuang HEBEI RIBAO in Chinese 18 Jun 83 p 1

/Excerpt/ The third phase of Tangshan's Douhe Power Plant, one of 70 key projects throughout the nation, is now taking shape.

The Tangshan Douhe Power Plant was approved by Chairman Mao and Premier Zhou and equipment for the whole plant has been imported from abroad. The project is divided into four stages. The first and second stages went into operation in 1978. Imported from Japan, machinery for the first and second stages consists of single series, completely automated equipment. The four steam turbine generators, with a total installed capacity of 750,000 kilowatts, will feed electricity into the North China Grid.

At the end of 1978, after the first and second stages were made available for use, the State Planning Commission officially ratified the tasks for the third stage of Douhe and recently placed it on the list of 70 key construction projects for the entire nation. The third stage includes the steam turbine buildings and the fifth and sixth generators, each with a capacity of 200,000 kilowatts, and the construction of an ash disposal pipeline almost 20 li long and a dump capable of storing ash for 20 years. The major part of the project is being designed by the Beijing Electric Power Design Institute. Principal equipment, such as the boilers, steam turbines, and generators, is being manufactured in Harbin; all equipment is electronically controlled and the degree of automation is very high. Today, a temporary enclosure for the plant buildings has been completed and a towering 100-meter-high retaining wall for the ash dump has been erected. The machinery is now in the installation stage and the No 5 generator will begin producing electricity by the end of the year. The construction of the third stage of the Douhe Power Plant will have a long-lasting impact on the industrial and agricultural production of the North China region, especially on the eastern Hebei economic zone now being built around Tangshan. It will also serve to ease the tense electricity supply situation for the Beijing-Tianjin-Tangshan area. After the No 5 generator becomes operational at the end of this year, the Douhe Power Plant will add another 200,000 kilowatts in installed capacity. When the third stage of the project has been completely finished, the plant will have the capacity to generate more than 8 billion kilowatt-hours of electricity a year, almost twice the amount of electricity produced by the entire nation in 1950.

Below we present some preliminary conceptions of the nature of scientific and technical progress in the coal industry during the next 18 years.

## I. Guiding Ideas

In conscientiously carrying on scientific work, we must orient ourselves to the general policy of economic construction, relate all work closely to the strategic objective of doubling coal output and assuring the quadrupling of national output value, proceed in terms of China's actual conditions, and take account of existing foreign scientific and technical achievements and development trends in order to promote the modernization of the coal industry.

We must take the key scientific and technical research projects which are urgently needed for coal industry production and construction, which will affect a broad area, and which will produce major economic results, as the objectives of our main effort. We must organize effective efforts in key scientific and technical areas, press forward in all areas, do everything possible to shorten the scientific research cycle, turn out results earlier, and see to it that scientific and technical work lead the way.

We must provide advanced technical facilities to establish coal production on a new technical base and to enable coal mining enterprises to carry out technical modernization and mine construction.

We should organize and coordinate our full range of activities, from scientific research and design to construction and production, so that scientific and technical results are disseminated and utilized as quickly as possible and become productive capabilities producing economic results.

## II. Strategic Objectives

By means of domestic research and imported technology, by the end of the century the technical situation in many key coal mines will reach the late 1970's or early 1980's technological level of the advanced coal-producing countries. We should strive to bring the technological situation in some coal mines, particularly opencuts, abreast of the advanced levels of that time.

## III. Key Strategic Points

There are five key points and three types of modernization.

The five key points are: speeding up coal exploration and coal mine and opencut construction; energetically promoting mechanization, focusing on coal cutting and transport equipment; improving safety; improving coal dressing, processing and utilization; and speeding up the training of scientific and technical personnel and making progress in science and technology.

The three modernizations are: technical modernization of mines; modernization of worn-out, out-of-date, and miscellaneous equipment; and technical modernization of local coal mines.

## A. Speeding up Coal Exploration and Coal Mine and Opencut Construction

The key concern in doubling coal output is effective, fast new mine construction. Currently the average construction time is 8 years; we should strive to decrease it to 6 years within 3 years of the end of the Sixth 5-Year Plan and to 5 years following 1990.

The critical areas of effort in speeding up coal development are as follows.

### 1. Improving the quality of geological exploration.

Currently the standards of coalfield geological exploration in China are low, the exploration cycle is long, and accuracy is poor. Our exploration techniques are only capable of finding faults with a vertical displacement of 30-50 meters or more. The amount of fully-explored reserves we now make available annually is 60 percent below future mine construction needs, so that it is far from fulfilling requirements. We should start improving geological exploration technology by improving exploration methods; we should aim at increasing speed and accuracy, and we should replace current methods based on drillhole exploration with combined drillhole and physical exploration. In drillhole exploration we should use semihydraulic drill rigs and the corresponding cable-mounted coring units, as well as diamond drill bits; we should use digital techniques in physical prospecting. In addition to developing series-type semihydraulic drilling rigs, bits, digital seismographs, electrical prospecting instruments and the like, we must also make active use of the truck-mounted 300-meter drill rigs intended for use in opencut mines, light digital seismographs, high-resolution digital seismographs, data processing technology, and digital well logging equipment. We must meet the requirement of providing enough fully-explored reserves every year to meet new mine construction, and we must increase exploration accuracy to the point that we can find faults with a vertical displacement of 15 meters.

### 2. We must speed up the rate of sinking vertical shafts and tunneling through rock.

Statistics indicate that vertical shafts account for about 5 percent of all mine tunneling, while the time required for them accounts for 40 percent of the total. Tunnels through rock account for about 50 percent of all tunneling and shaft sinking, while the time spent on them accounts for about 40 percent of the total. Currently the vertical shaft completion rate is only 17 meters per month and the rock tunneling rate is only 50 meters per month; if these rates could be increased, this would have a decisive effect in cutting the time required for mine construction.

Shaft sinking methods and full-face tunneling equipment should be fully mechanized, including rock breaking, loading and use of supports, and the processes should be made continuous; improving engineering quality, increasing safety and increasing rate of advances are major areas of effort in vertical shaft and rock tunnel construction.

In vertical shaft sinking, we should begin by expanding construction technology based on the shaft drilling method and mechanizing the sinking of vertical shafts. The newly developed mechanized vertical shaft sinking lines must be improved and all auxiliary equipment integrated into them so that they become productive capabilities and yield results, thus giving us experience and enabling us to develop powerful drilling rigs and high-efficiency construction equipment. In rock tunneling, we must improve the mechanized tunneling lines that have been developed, provide all supporting equipment for them, and develop them into four types of work lines based on side-loaders, large bucket loaders, and large and small tunneling and loading units, and we must develop full-face rock tunneling machines. We must strive to achieve a national average of 30 meters per month within 3 years of the end of the Sixth 5-Year Plan and 45 meters per month during the Seventh 5-Year Plan period. Our national average for rock tunneling should be increased to 75 meters per month within 3 years of the end of the Sixth 5-Year Plan and to 90-100 meters per month during the Seventh 5-Year Plan.

3. We must restructure the tunnel development layout.

The amount of tunneling per 10,000 tons of coal has stood at about 200 meters for a long time, while construction of a 3 million ton mining base requires 60,000 to 70,000 meters of tunneling; in order to decrease mine construction time we must fundamentally restructure the coal mine development layout and do everything possible to increase mechanization, implement centralized production, utilize extraction not based on coal pillars, use sloping longwall extraction in areas where it is suitable, and make every effort to decrease the amount of rock tunneling. To this end, we must study and solve problems involving tunneling supports and tunnel protection technology for large-cross-section tunnels through coal seams, as well as auxiliary transport equipment; we must produce rolled 29-kg and 36-kg channel steel for arch supports, and we must import and assimilate tunneling devices for tunneling through coal and partly through coal, in an effort to decrease the amount of tunneling per million tons of coal to 50 meters and to decrease the mine construction period by a year.

4. We must develop new technologies, new processes, and large-size equipment for opencut mines.

In order to develop large opencuts, we must improve the current technical and equipment situation in opencut extraction. We must energetically use advanced continuous and semicontinuous techniques, internal overburden disposal and truck-transported coal extraction techniques, and large-scale bucket-wheel excavators, electric power shovels, steam shovels, conveyor belts and the like. By 1985 we must master the design technology for large-scale opencuts as well as gradually mastering equipment manufacture technologies.

While speeding up mine construction, we must also solve the problems of large-size mine electrical equipment, such as electrical control equipment for large-scale multicable winches and downward conveyors, and energy-saving, long-lived, efficient blowers, water pumps and the like.

We must pursue research, experimentation and spot experiments in pipeline coal transport and strive to put it into production use at an early date.

After summarizing domestic and foreign experience, we must develop surface production systems which take up little ground space, exert little pressure on the coal seams, are rationally laid out for storage, unloading, transporting, measuring and dispatching, and can operate with long coal trains.

#### B. Energetically Develop Mechanization, Focusing on Coal Cutting and Transport

According to 1982 statistics, the degree of mechanization of coal extraction in China was 40 percent, while the degree of mechanization of tunneling was 39.7 percent. In order to steadily increase the output of existing mines and assure that new mines will rapidly achieve their rated output, it will be necessary to increase the degree of mechanization of both extraction and tunneling to more than 46 percent by 1985, to 60-70 percent by 1990, and to 80-90 percent by the end of the century.

The guidelines for developing the mechanization of coal extraction are: with a general orientation toward comprehensive extraction, we must energetically develop high-grade conventional extraction before 1990 and consolidate and increase ordinary conventional extraction; in mines where considerable variations in seam thickness make mechanized extraction difficult, hydraulicking should be energetically pursued. In addition, we must effectively manage and utilize existing coal extraction machinery and continuously improve the unit workface output.

The main areas of effort in mechanization are as follows.

1. In coal extraction, we must achieve mechanization of thin seams and thick seams, and mechanization of coal extraction below broken roof rock.
2. In tunneling, we must mechanize tunneling in coal and partially in coal.
3. In transport, we must increase the service life of scraper conveyor components and develop uphill and downhill belt conveyors and strong fire-resistant rubber belts.
4. We must make mechanical equipment more economical, increase component quality, lengthen service life, and decrease production costs in order to increase the economic effect of mechanization.

Currently, resources in thin seams account for 20.2 percent of total reserves, while their share of output is only 12.6 percent; the main reason for this imbalance is a lack of cutting machinery and supports for thin seams. Reserves in thick seams account for a large proportion of the total, 45 percent, and they have considerable potential for increasing coal output; the main current problem is the lack of high-power extraction machinery and thick-seam supports. Of reserves to be subjected to machine extraction in 38 major mining districts, 54 percent are in seams with broken roof rock, to which existing cutting machines cannot be adapted. Therefore, solving the

problems of coal cutting in thin and thick seams and under broken roof rock conditions is the key to stable, sustained increases in the degree of mechanization. We should speed up research and development and strive to produce cutting machinery for thin and thick seams and for seams with broken roof rock, as well as thin-seam coal plows during the Sixth 5-Year Plan. During the Seventh 5-Year Plan period we must achieve mechanization of steeply sloping seams and put cutting and tunneling machinery into series production so that the number of workfaces with mechanized extraction increases from the current figure of 586 to 741 in 1985 and 1,142 in 1990, and so that mechanization of tunneling keeps pace with mechanization of extraction.

### C. Improving Mine Safety

The basic way of improving mine safety in China is to place mine safety work on a modern scientific and technical basis. To improve mine safety we must follow the guideline of "emphasizing prevention, comprehensive management, across-the-board progress, and making science and technology lead the way," and achieve the following three objectives.

1. By the end of the century, the safety situation in all central-distribution and key coal mines must reach present advanced-world standards.
2. By the end of the century we must have essentially controlled major gas, coal dust, fire and flooding accidents, and by 1990 central-distribution coal mines must have largely controlled gas and coal dust explosions.
3. We must strive to make the rate of black lung disease decrease by 1986 and basically eliminate harm from coal dust by the end of the century.

The main areas of effort in safety technology are as follows.

1. Protecting against gas and coal dust explosions. The main reason for gas and coal dust explosions is accumulation of gas above limiting levels and the presence of sources of fire. In order to prevent gas and dust explosions, we must focus on gas ejection, improve ventilation conditions, institute effective monitoring systems, and control sources of fire.
2. Protecting against roof collapse accidents. The main reasons for roof collapse are failure of supports, insufficient bearing capacity of supports, or working under unsupported roof rock. In order to prevent roof collapse, we must actively develop comprehensive coal extraction and unitized hydraulic supports, choose coal cutting methods correctly, and focus on improving roof support technology, support quality, and roof rock monitoring methods.
3. Preventing hoisting and transport accidents. The main causes of these accidents are cable breakage, runaway cars, derailment, and collisions. In order to prevent them we must focus on improving hoisting and transport conditions, improving transport methods, increase equipment reliability, and improving protective facilities.

4. Guarding against the harm done by coal dust and controlling the incidence of black lung disease. We must focus on comprehensive dust prevention, dust monitoring, and prevention and treatment of black lung disease.

We must start by improving existing prevention and treatment techniques, round out the complement of equipment, draft relevant regulations and standards, and strive to make breakthroughs in certain key areas for prevention of such accidents during the Sixth 5-Year Plan. For example, we should do effective work in such key technical efforts as high back pressure, close hole spacing and long-term ventilation techniques for gas ejection and produce safety monitoring components. A full complement of gas monitoring instruments should be in place by 1985, a few mines should have established safety monitoring systems, gas ejection should have increased from the current 300 million cubic meters to 400 million cubic meters, and dust concentrations in tunnels through rock should have been brought close to state standards; by 1990, a group of coal mines should have established safety monitoring systems, gas ejection should have increased to 600 million cubic meters, and efforts should be made to bring dust concentrations in tunnels driven through coal close to state standards.

#### D. Developing Coal Dressing, Processing and Utilization

Developing coal dressing and processing technologies, improving coal quality, increasing the number of varieties and using coal rationally constitute an important link in conservation and in achieving doubled coal output in support of quadrupled national output. The guidelines for coal dressing, processing and utilization are the "three changes and one development," namely, changing low quality to high quality, changing from a single product to a variety of products, and changing from a single type of operation to diversified operations, and developing from low-level processing to high-level processing.

The directions of main effort in coal dressing, processing and utilization technology are: increasing the proportion of coal which is dressed and processed and developing high-efficiency processing equipment; increasing the comprehensive utilization of low-caloric-value fuels and by mineral by-products; producing formed coal; and actively carrying on experiments in coal gasification and liquification and the preparation and combustion of coal slurries.

##### 1. Energetically developing coal dressing and processing.

In accordance with natural conditions, water supplies and user requirements, when coal plants are built or expanded they should be provided with dressing and classification plants of the requisite capacity; these should be designed, built and put into production at the same time as the new plants, while in the case of old mining districts, dressing plants and classification and processing systems should be gradually added or expanded as mine conditions permit. In the case of nearly exhausted mines or local mines, simple classification and dressing measures should be adopted in accordance with actual circumstances. Technical modernization of existing dressing and

classification plants should be carried out, their production capacities should be expanded in accordance with needs, and moisture removal and coal sludge recovery systems should be established and improved. Domestic coal dressing processes and equipment should be improved. The proportion of coal sent for dressing should be increased to 80 percent by the end of the century, and by 1990 we should see to it that varieties of coal of different quality are provided for metallurgy, chemical fertilizer production, locomotive use, power plants, export and other uses.

2. Develop the comprehensive utilization of low-caloric value coals and mineral by-products.

We must start by utilizing the 23 million tons of coal dressing waste produced annually. The waste with a caloric value exceeding 1,300 kcal/kg should be processed for use in evaporation boilers and the use of low-caloric value fuels for generation of electricity should be vigorously pursued. Coal dressing waste with a caloric value of 500 to 1,300 kcal/kg, should be used for mining district building materials. In the case of the 70 million tons of coal mine gangue produced every year, the usable low-caloric-value fuel should be extracted from it and it should be used for building materials or mining district land reclamation. The by-product iron sulfide ores should be recovered.

3. Actively conduct experiments in coal gasification and liquification.

We should focus on developing mining district gas utilization and gasification. The evaluation of the capabilities of high-pressure coal gasification, small-scale liquification experiments, and small- and medium-scale experiments in the preparation and combustion of coal slurries should be completed by 1985. By 1990, intermediate-scale experiments in coal liquification and the industrial-scale preparation and combustion of coal slurries should be completed, and an effort should be made at comprehensive utilization of byproduct coal gas where conditions permit; a group of coal gasification districts should be established where possible.

In environmental protection, during the Sixth 5-Year Plan period we should actively conduct mining district environmental effect evaluations and research in environmental monitoring techniques and establish models for imitation; during the Seventh 5-Year Plan period we should comprehensively pursue pollution management, achieve complete closed-cycle utilization of the water in coal dressing plants, assure that the water that is discharged meets discharge standards, and focus on land reclamation in mining districts.

E. Speed up the Training of Scientific and Technical Personnel and Develop Science and Technology

Education is the foundation for developing science and technology. Currently the proportion of scientific and technical personnel in the coal industry system is rather small. We must increase our investment in intellectual resources and speed up the training of scientific and technical personnel; the key is effective work with all types of coal industry schools, the use of

modern teaching techniques, the use of social forces, development of extensive avenues, and effective large-scale, widespread on-the-job training and education for employees. In the next 18 years the coal industry's intermediate and higher schools must train a large contingent of scientific and technical specialists in order to meet the needs of scientific and technical development in the coal industry.

To develop coal science and technology, scientific research must lead the way. We must speed up the construction of coal scientific research organizations, enrich our research resources, and master scientific and technical developments in the coal industry at home and abroad. We must accord full importance to basic research and software development for applied coal mining technology, including development of coal mining technical policy, technical standards, and technical rules and regulations, research and drafting of materials on coal district geology and basic conditions, as well as determination of coal mining environmental conditions and basic technical requirements. By the end of this century, we must have developed a coal science and technology research system with a full complement of specialties, rationally distributed, in which specialized and mass-style activities are combined, establish the corresponding research and experimental centers and information centers, each with its own special characteristics, and establish a red-and-expert scientific and technical contingent which is capable of independently solving coal industry scientific and technical problems and which includes a group of high-level experts.

#### F. Improvement of Mine Technology

Reform of existing mining technology to expand production capabilities requires little outlay, gives a return quickly, and produces good economic results. The areas of main effort are as follows: 1) restructuring extraction processes; 2) developing the complete mechanization of all production links, focusing on mechanization of extraction and tunneling; 3) improvement of safety measures; 4) increasing the number of varieties; 5) instituting scientific management; or, in other words, specialization of production, mechanization of extraction and tunneling, basing safety monitoring on instrumentation, diversifying operations, and making management scientific. In the next 2 to 3 years we must concentrate our forces for some key technical modernization of mines.

#### G. Technical Modernization of Local Mines

Local coal mines are an important component of the coal industry which have an increasing role in developing energy resources and invigorating the local economy. Based on the guidelines for local mines, namely "support, streamline, modernize and combine," the main focus on technical modernization of local mines is improvement of safety conditions, improvement of extraction methods, increasing resource recovery rates, increasing the level of small-scale mechanization, and promoting conventional extraction and high-grade conventional extraction on workfaces where conditions permit.

#### H. Renovation of Worn-Out, Out-of-Date or Nonintegrated Equipment

Currently, two-thirds of electricity use in central-distribution mines is for hoisting, air compression, ventilation and water and gas removal; therefore the main focus of renovation of worn-out, out-of-date and miscellaneous equipment is on these four activities, and particularly on ventilators, water pumps and compressors. At present some 45 percent of all equipment of this type needs modernization and provision of the appropriate testing facilities; if, after modernization, they can be operated with high efficiency, it will be possible to save large amounts of electric power every year.

More than 30 percent of the equipment in plants producing equipment specially for the coal industry has been in operation for about 20 years. It consumes large amounts of electricity, and its precision is insufficient to meet requirements. There is a lack of basic measuring instruments and key precision equipment for manufacturing new types of coal extraction and tunneling equipment. In order to meet the needs of the mechanization of extraction and tunneling equipment, during the Sixth 5-Year Plan we must focus on modernization and supplementation of the equipment in four manufacturing plants producing coal extraction machinery, hydraulic supports and safety monitoring instruments.

#### IV. Strategic Program

This is divided into three stages: 3 years for laying the foundation, 5 years for technical upgrading, and 10 years for popularization. In the first 3 years we will focus on efforts in critical areas, and will concentrate our forces on a few key technical points urgently needed for production and construction. During the Seventh 5-Year Plan period, we must upgrade technology on the basis of the foundation laid during the Sixth 5-Year Plan so that the basic technical problems of the production buildup will be solved. In the subsequent 10 years, in coordination with the overall development of the coal industry, late-1970's-early-1980's advanced technology will be disseminated in the central-distribution and key coal mines, and we will make a series of focused efforts to make coal science and technology approach or reach advanced world standards so that some technologies will be close to or abreast of advanced world technology.

It is estimated that by the end of the century, we will have suitable technical equipment of the kinds which the advanced countries now possess, and that in terms of varieties and reliability it will be at the level attained by the advanced countries in the late 1970's and early 1980's, while in some technologies we will be close to or abreast of advanced world standards. The central-distribution and some local coal mines will focus on mechanization of production; the degree of mechanization will reach 80-90 percent. Production will be doubled without any major increase in personnel. We will have brought major accidents and occupational diseases under control. Most of the output of most central-distribution and some local coal mines will be subjected to dressing and processing, with a dressing rate of 80 percent. We will supply a variety of coal products to different users and

create the conditions for social conservation and environmental protection. There will be a group of coal gasification districts and some combined coal-fired electric power production and coal chemistry bases. The main avenue of coal transport will be large-tonnage trains, while pipeline transport will also have come into use. Computer technology will have come into wide use in geological prospecting, design, scientific research, management, and the control of some production processes.

The above will constitute a fundamental transformation of our coal mines and will modernize the coal industry.

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## COAL

### NEW MANAGEMENT TAKING OVER KEY COAL CONSTRUCTION PROJECTS

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[Report by reporter Huang Fengchu]

[Excerpts] The Ministry of Coal Industry is improving the management of and leadership over key construction projects and is conscientiously solving the major problems of waste caused by poor management and substandard construction quality of some key projects.

There are eight large- and medium-sized coal mine projects now under construction. Their total designed production capacity is 50.4 million metric tons of raw coal a year.

In order to ensure the smooth progress of the construction of the key projects and to timely solve the problems encountered during construction, the Ministry of Coal Industry and the State Planning Commission have since last April jointly organized five inspection groups. The inspection groups have inspected each of the key construction projects at Gujiao and Datong in Shanxi, Huolinhe in Nei Monggol, Yanzhou in Shandong, Pingdingshan in Henan, Tiefa in Liaoning, and Huaibei and Huainan in Anhui. They found that the construction of most of the projects had been speeded up and were proceeding quite smoothly, but the construction of some other projects had been delayed due to poor management and substandard construction quality which had caused serious financial loss to the state.

Because of reorganization of the construction forces and poor leadership, only 9,500 meters of tunnels have been dug in Datong's Yanzishan mine since work began in 1980. Moreover, most tunnels were not up to standard and needed to be repaired. As a result, the mine will be able to produce only 1 million metric tons of coal annually, instead of 2 million metric tons as originally designed, upon completion of its first phase construction in 1985.

The inspection groups seriously criticized Pingdingshan's No 8 mine and Tiefa's Xiaoqing mine for their poor construction quality and serious wastes. Due to lack of attention to construction quality, more than 12,900 meters of tunneling in the second phase construction of Pingdingshan's No 8 mine need repair. This will take an additional investment of 5.8

million yuan. The construction of Tiefu's Xiaoqing mine began in May 1975. Of the 22,700 meters of tunnels dug in the past 7 years or so, 8,000 meters need to be repaired. This has caused a loss of more than 3 million yuan.

In view of the problems existing in the eight key construction projects, the leading comrades of the Ministry of Coal Industry have made on-the-spot inspections, heard reports of the inspection groups, held a telephone conference of the coal industry across the country and put forward several measures to speed up the construction of the key projects. The major steps taken are: 1) A leadership group composed of personnel from the geology, design, capital construction, planning, supply and labor departments has been set up to constantly control the construction progress of the key projects, coordinate all the aspects of work, exercise constant supervision and inspection and hold overall balancing meetings regularly. 2) A key-project office has been set up to timely reflect the existing problems and see to it that they are handled by the units concerned. 3) Inspectors have been assigned to make monthly inspections of the eight major mining areas or are stationed at the mining areas to solve the existing problems. 4) The mining bureaus have appointed managers to take charge of the key projects and the construction enterprises have assigned people to take charge of each item of construction. They will be responsible for the key projects until they are completed. They will not be replaced unless they are incompetent or for special reasons.

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## COAL

### NINE MINING REGIONS EARMARKED FOR FOREIGN INVESTMENT, CO-DEVELOPMENT

Beijing SHIJIE MEITAN JISHU [WORLD COAL TECHNOLOGY] in Chinese No 6, Jun 83  
pp 2-4

[Article by Wu Yaxing [0702 7161 5281], chief engineer, Planning Department, Ministry of Coal Industry: "Proposed Coal Mine Development Projects for Co-operation With Foreign Countries"]

[Text] Coal, a major source of energy in China, plays a role of paramount importance in our national four modernizations program of construction. In the next 18 years, the coal output of China will increase from today's 650 million tons (the 1982 actual coal output) to 1.2 billion tons. This includes a net production increase of 50 million tons--an increase from 350 million tons to 400 million tons--by the existing coal mines built, operated, and managed by the Ministry of Coal Industry, after undergoing technological reform and after making allowances for the reduced production of some aging and abandoned coal mines. And this also includes another net increase of approximately 200 million tons--an increase from 300 million tons to 500 million tons--by the local coal mines.

In addition there is a projected increase of more than 300 million tons of coal to be achieved jointly by the newly developed openpit coal mines and the newly built coal mines. A tentative projection calls for an increase of 200 million tons in coal production by the newly developed, large-scale, openpit coal mines, and for another increase of 200 million tons in coal production by the newly built coal mines. We believe that it is possible to achieve the above-mentioned goal on the basis of China's resources, the existing technological base, and the energy resources development principle determined by the state. It goes without saying that we still need international cooperation.

The available development projects of cooperation with foreign countries involve 9 mining areas covering 17 coal mines and 6 openpit coal mines, which have a total projected capacity of 130 million tons.

#### I. Pinglu-Shuoxian Mining Area

This mining area is located in Pinglu and Shuoxian Counties in northern Shanxi Province covering 380 square kilometers, with proven reserves of 12.7 billion tons of coal. Our preliminary plan is to open up three openpit coal mines before 1990:

1. Antaibao No 1 Openpit Coal Mine. The projected output capacity is 15 million tons per year, with a defined exploitable reserve of 500 million tons, an average excavation ratio of 5.13 cubic meters/ton. It has been decided that this coal mine is to be jointly developed and financed and managed in cooperation with the Island Creek Coal Company of the U.S. Occidental Petroleum Corporation.

2. Antaibao No 2 Openpit Coal Mine. The projected output capacity is 15 million tons per year, with exploitable reserves of 650 million tons, an average excavation ratio of 5.13 cubic meters/ton.

3. Anjialing Openpit Coal Mine. The projected output capacity is 15 million tons per year, with exploitable reserves of 610 million tons, an average excavation ratio of 5.53 cubic meters/ton.

It is proposed that the second and third openpit coal mines enter into a new cooperation with foreign countries.

## II. Lu'an and Jincheng Mining Areas

Located in southeastern Shanxi Province, the Lu'an mining area covers Huanyuan County, Tunliu County, and Changzhi City, whereas the Jincheng mining area embraces Gaoping, Jincheng and Yangcheng Counties. The Lu'an mining area has a geological reserve of 15.8 billion tons. The Jincheng mining area has a geological reserve of 33.5 billion tons. Scheduled to be built before 1990 are the following four coal mines:

1. Chengzhuang Oblique Coal Mine, Jincheng: Projected capacity 4 million tons per year. Geological reserve 940 million tons. Construction to start in 1984. Production to begin in 1989.

2. Changcun Vertical Coal Mine, Lu'an: Projected capacity 4 million tons per year. Geological reserve 740 million tons. Construction to start in 1985. Production to begin in 1990.

3. Sihe Oblique Coal Mine, Jincheng: Projected capacity 4 million tons per year. Geological reserve 1.25 billion tons. Construction to start in 1986. Production to begin in 1991.

4. Tunliu Vertical Coal Mine, Lu'an: Projected capacity 4 million tons per year. Geological reserve 1.16 billion tons. Construction to start in 1986. Production to begin in 1991.

It is proposed that the World Bank loans be secured for the first and second coal mines, and that other channels of cooperation with foreign countries be sought for the third and fourth coal mines, including, of course, ongoing cooperation with the World Bank.

## III. Jungar Mining Area

Located in the western sector of the Nei Monggol Autonomous Region, 150 kilometers north of Hohhot Municipality, the Jungar mining area has a railroad

branch line leading to Hohhot Municipality, which has been incorporated into the state plan, plus a projected special coal railroad running directly from the mining area to Qinhuangdao via Datong. This mining area covers 1,723 square kilometers, with a geological reserve of 24.06 billion tons. Planned to be built before 1990 are the following two openpit coal mines:

1. Heidaigou Openpit Coal Mine: Projected capacity 25 million tons per year. Verified geological reserves 1.56 billion tons. Average excavation ratio 4-6 cubic meters/ton.
2. Yaogou Openpit Coal Mine: Projected capacity 10 million tons per year. Proven geological reserves 5.5 billion tons. Average excavation ratio 6-8 cubic meters/ton.

Planned to be built in the Jungar mining area is a joint enterprises comprehensive project for unified management and control of openpit coal mines, pit-mouth power plants, and coal pipelines which are now being designed in cooperation with the U.S. Bechtel Corporation. We welcome cooperation in the area of providing technology and equipment and pooling of capital for a joint venture.

#### IV. Panxie Mining Area

Located in Huainan Municipality, Anhui Province, the Panxie mining area plans to build four vertical coal mines, namely, the Xieqiao vertical coal mine, 4 million tons per year; the Zhangji vertical coal mine, 4 million tons per year; the Guqiao vertical coal mine, 4 million tons per year; and the Guiji vertical coal mine, 4 million tons per year. The total projected capacity of the four coal mines is 16 million tons per year.

#### V. Jining Mining Area

This mining area is located in Jining Municipality, Shandong Province. Running through the mining area from west to east is the Heze-Jining-Yangzhou Railway which links up with the Jin-Pu Railway. A special coal railway line leading from Yangzhou to the port of Shijiusuo is being built and will be open to traffic in 1985. The railway linking Heze with Xinxiang is now incorporated into the state capital construction plan. Therefore, this mining area is well furnished with adequate means of communications.

This mining area has a total prospected area of 560 square kilometers, proven reserves 2.956 billion tons, five coal mines scheduled for construction for a total projected output capacity of 720-840 million tons per year. Of the five coal mines, the Liying vertical coal mine (the No 2 vertical coal mine) has decided to enter into a technological cooperation with the British Shell Corporation. The other four coal mines still available for development in cooperation with foreign countries are:

Xuchang Vertical Coal Mine: Area of coal mine 104 square kilometers; geological reserve 679.65 million tons, mostly deposited beneath Jining Municipality; projected capacity 0.9 million to 1.2 million tons.

Daizhuang Vertical Coal Mine: Area of coal mine 71 square kilometers; geological reserve 383.94 million tons; projected capacity 0.9 million to 1.2 million tons.

Xindian Vertical Coal Mine: Area of coal mine 87 square kilometers; geological reserve 719.71 million tons; projected capacity 2.4 million to 3 million tons.

Sihekou Vertical Coal Mine: Area of coal mine 30 square kilometers; geological reserve 116.99 million tons; projected output capacity 0.6 million tons.

#### VI. Yiminhe Mining Area

This mining area is located at the Hulun Buir Steppe in the eastern part of the Nei Monggol Autonomous Region. The entire mining area is divided into two sectors--the southern mining sector and the northern mining sector.

The southern mining sector, 76 kilometers south of Hailar Municipality, has proven reserves of 5.05 billion tons. Planned for development in this mining area are five openpit coal mines, of which the No 1 openpit and the No 2 openpit coal mines are scheduled to be built before 1990. The No 1 openpit coal mine has a geological reserve of 137.53 million tons, an average excavation ratio of 1.84 meters<sup>3</sup>/ton, and a projected capacity of 5 million tons per year. It plans to adopt single-bucket and auto-transport technology. The No 2 openpit coal mine has a geological reserve of 972.8 million tons, an average excavation ratio of 2.5 meters<sup>3</sup>/ton, and a projected capacity of 15 million tons per year. It plans to adopt wheel-bucket-excavator and belt-conveyor-transport technology.

The northern mining sector, 10-15 kilometers north of Hailar Municipality, has proven reserves of 5.5 billion tons. Planned for development in this mining area are three openpit coal mines, each of which has a preliminary projected capacity of 10 million tons per year, an average excavation ratio of 4-5 meters<sup>3</sup>/ton. Excavation technology remains to be finalized. We prefer adopting continuous excavation technology centering on wheel-bucket excavation.

We are preparing to make the construction of the Yiminhe mining area a joint enterprise centering on openpit coal mines and pit-mouth power plants.

#### VII. Huating Mining Area

This mining area is located in Huating County, Gansu Province. It covers a coal-bearing area of 118 square kilometers, a prospected and ascertained geological deposit of 3.26 billion tons, which includes verified geological reserves of 880 million tons. Projected capacity of this mining area is 1.2 million tons, which includes a projected capacity of 0.9 million tons for each of the three coal-producing mines already built. Also planned to be built are the following six coal mines.

Yanxia Coal Mine:	projected annual output capacity 3.6 million tons;
Daxin Coal Mine:	projected annual output capacity 3.0 million tons;
Chenjiagou Coal Mine:	projected annual output capacity 0.9 million tons;
Yangma Coal Mine:	projected annual output capacity 0.9 million tons;
Baicaoyu Coal Mine:	projected annual output capacity 1.8 million tons;
Liujiahe Coal Mine:	projected annual output capacity 1.2 million tons.

#### VIII. Xianning Mining Area

This mining area, located in southwestern Shanxi Province, covers 611 square kilometers. Reserves total 5.323 billion tons, which includes 1.932 billion tons in 195 square kilometers of the prospected Wangjialing area where coal deposits have been verified.

In light of vein conditions and reserves determined by careful exploration, it is possible to build in the coal-producing Wangjialing locality horizontal mines producing 10 million tons of coal a year or oblique mines producing 8 million tons of coal a year.

#### IX. Shenmu Mining Area

This mining area is located in Yulin Prefecture, northern Shaanxi. It embraces 12 counties, including Shenmu and Fugu Counties.

The coal mines in this area cover 7,050 square kilometers, with reserves of 72.9 billion tons. As indicated by current prospecting, it is still in the coal-finding stage. A general investigation report is expected to come in by 1984.

#### X. Local Coal Mines

The above-mentioned nine mining areas, commonly known as unified distribution coal mines are to be constructed by the Ministry of Coal Industry and will be operated and managed by it after consummation of the building projects. Where conditions are appropriate, it is permissible to embark on a course of cooperation with foreign countries in such coal mines as:

##### (1) Nanzhai Coal Mine

This coal mine is located in the south of Changzhi Municipality, Shanxi Province, having proven reserves of 323.05 million tons, an exploitable reserve of 197.8 million tons.

Conditions exist for construction to begin on this mine. Highways and railways are now open to traffic and the center of the coal mine is only 5,000 meters away from the regional power transformer station. Water supply comes from the Zhang He Reservoir. Projections call for the building of a coal mine producing 0.9 million tons per year, a coal mine which integrates vertical with oblique patterns. Construction of this coal mine is scheduled to start in 1984.

(2) Makou Coal Mine

This coal mine is located in Jingergou Commune, Zuoyun County, Shanxi Province, covering an area of 11.41 square kilometers, with a geological reserve of 182.39 million tons, an exploitable reserve of 127.35 million tons.

The coal mine has a projected capacity of 0.9 million tons per year, a life of 101 years.

Construction of the mine has already started. Designed sinking and driving engineering is 22,600 meters, of which 11,528 meters have been completed as of this writing.

The period of construction is 5 years. The mine will begin production in 1986.

(3) Dianwan Coal Mine

This coal mine is located in Jingergou Commune, Zuoyun County, Shanxi Province. It has a geological reserve of 119.67 million tons, an exploitable reserve of 83.83 million tons.

Projected capacity of the mine is 0.6 million tons per year. Construction of the mine was started in 1981 and will take 4 years to complete. It is expected to start producing coal in 1985.

(4) Chaochuan No 3 Coal Mine

This coal mine is located within 15 kilometers of Xiaotun Commune, Linru County, Luoyang Prefecture, Henan Province. The Jiaozhi Railway runs through the eastern part of the coal mine. A special railway line is now basically open to traffic.

The coal mine covers an area of 11 square kilometers, with a geological reserve of 125,647,600 tons, an exploitable reserve of 79,064,400 tons.

Projected capacity of the mine is 0.9 million tons per year. The entire coal mine is composed of two vertical mines and two horizontal mines. The main vertical mine is 512 meters and the auxiliary vertical mine is 712 meters in depth. Construction of this coal mine will take 49.4 months to complete, and it will have a service life of 62 years.

At present, this coal mine has water, power, and roads. Digging of the main and auxiliary coal mines has reached a depth of 35 meters.

(5) Nanchuan Coal Mine

This coal mine is located in Qilizhen Commune, Huangling County, Shaanxi Province, covering an area of 26.3 square kilometers, with a geological reserve of 74.19 million tons, an exploitable reserve of 51.93 million tons, and a projected capacity of 0.45 million tons per year.

(6) Renlou Coal Mine

This coal mine is located in the intersection of Suixi and Mengcheng Counties, about 30 kilometers southwest of Suxian County, Anhui Province. It occupies an area of 43 square kilometers.

The coal mine has a geological reserve of 296.87 million tons, an exploitable reserve of 178.63 million tons, and a projected capacity of 1.5 million tons per year. Construction of this mine is scheduled to start in 1984.

Apart from the aforementioned projects (9 unified distribution coal mines built and operated by the Ministry of Coal Industry and 6 local coal mines), we plan to build during the Sixth 5-Year Plan (1981-1985) and the Seventh 5-Year Plan (1986-1990), 10 huge openpit coal mines, about 100 big and medium coal mines each having an annual capacity of 0.9 million tons, plus a massive technological reform of the existing 500 producing mines. As long as the relevant quarters are interested in this and are willing to cooperate with us in development, I believe coal mining will have a broad avenue of development.

12315

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## COAL

### AGREEMENTS SIGNED WITH EUROPEANS, CANADIANS TO DEVELOP SOUTHWEST COAL

Beijing SHIJIE MEITAN JISHU [WORLD COAL TECHNOLOGY] in Chinese No 6, Jun 83  
pp 5-6

[Article by Ling Peihong [0407 0160 1738], chief engineer, China National Southwest Energy Resources Joint Development Corporation: "Using Foreign Investment To Accelerate Development of Energy Resources in Southwest China"]

#### [Text] I. Introduction

The five southwestern provinces (regions) of China--Guizhou, Yunnan, Sichuan, Guangdong and Guangxi--are rich in energy resources. In the two provinces of Yunnan and Guizhou, there is a proven reserve of more than 62 billion tons of coal, about 10 percent of the total proven reserve of the whole nation. Moreover, coal in the two provinces is excellent in quality and complete in variety, consisting of primary coking coal, brown coal (lignite), soft coal (bituminous coal), hard coal (anthracite), etc.

The proven coal reserves in Guizhou Province, including its six mining areas in Luzhi, Panjiang, Shuicheng, Zhijin, Nayong and Xingyi, are approximately 46.2 billion tons. Of the six mining areas, three--Luzhi mining area, Panjiang mining area, Shuicheng mining area--possess proven reserves of about 20.3 billion tons. In these three mining areas are 21 built and developed coal mines operating at a projected annual capacity of 10 million tons; they achieved an actual output of 7 million tons in 1982. The other three mining areas in the province are still awaiting exploitation.

In Yunnan Province, the proven reserves are about 16 billion tons, including more than 11.8 billion tons of brown coal, 3.8 billion tons of soft coal, more than 300 million tons of hard coal.

Guangdong is a coal-deficient province. In Changbo, Hainan Island, which is under the jurisdiction of Guangdong Province, there is one lignite field with a reserve of about 300 million tons (thermal output 2,500 calories/kilogram) plus a clay coal deposit of about 100 million tons, an oil shale deposit of about 8 billion tons having an oil-bearing rate of 5-8 percent, a sulphur content of 1-3 percent, and a thermal value of 1,300-1,700 calories/kilogram.

In addition, hydraulic resources and geothermal resources in Southwest China have great potential awaiting further utilization and exploitation.

The five provinces (regions) of southwest China are rich and fertile not merely in energy resources, but also in other material resources, such as, tin, mercury, manganese, aluminum, zinc, iron ore, phosphate ore, alumina, etc. At present, because of inadequate communications and transportation, and because railways, highways and harbors require renovation or construction, these natural resources remain untapped and undeveloped. It is for this reason that the State Council has adopted a decision in connection with the founding of a "China National Southwest Energy Resources Joint Development Corporation," which is entrusted with the task of using foreign investments to accelerate development of the southwest's energy resources. This starts first and foremost in the domain of energy resources, in opening up coal mines, in building railways and ports and power stations, followed by further development of the southwest's material resources.

## II. Concept for Development of Southwest China

The prevailing task is primarily one of developing the southwest's coal resources for export, for power generation, for comprehensive utilization, simultaneously with enhancement of railroad capacity and harbor loading-unloading capacity.

### 1. A Projected Two-Step Coal Development

First Step: Measures for adoption in this phase of development are streamlining and revamping of enterprises, strengthening of management, and upgrading of mechanization level. Existing coal mines and coal-dressing plants are to be properly equipped, renovated or expanded, so that productivity can be raised from 7 million tons to 15 million tons a year.

Second Step: Measures to be taken in this phase of development include construction in the two provinces of Yunnan and Guizhou of new coal mines with an annual capacity of 25 million tons, thus raising the total annual capacity of mines built and operated by the Ministry of Coal Industry to more than 40 million tons, that of coal-dressing plants to 20 million tons, and that of the small provincial-local jointly operated coal mines to 5 million tons. To this is added a development of the Xianfeng and the Zhaotong openpit coal mines in Yunnan Province which have an annual output capacity of 33 million tons, in addition to development of an openpit coal mine in Changbo County, Hainan Island, Guangdong Province, which has an annual output capacity of 2 million tons.

The above coal mines will have a total annual output capacity of 60 to 80 million tons of coal.

### 2. Railway Construction

First Step: The existing railways (from the Liupanshui coal mine to the port of Zhanjiang, Guangdong Province, 1,900 kilometers total length) will be re-engineered, thus achieving electrification of transportation and the repairing or building of double-line railways to increase annual transportation capacity from 6 million tons at present to 12 million tons.

Second Step: A new railway leading from Hongguo to Nanning, Guangxi Province, 600 kilometers in length, will be built to shorten the distance of transportation by 860 kilometers and to increase annual capacity by 20 million tons, as compared with existing railways.

### 3. Harbor Construction

First Step: The third operation area of Zhanjiang Harbor, Guangdong Province, the construction of which has now been completed, will be expanded into a port capable of handling ships of 50,000 tons and of exporting 4 million tons of coal per year.

Second Step: A special coal-exporting pier, capable of accommodating cargo ships of 100,000 to 150,000 tons, with an annual loading capacity of 10 million tons, will be built in Zhanjiang Harbor, Guangdong Province. In addition, a pier capable of handling ships of 50,000 tons will be built at Fangcheng Harbor, Guangxi Province.

### 4. Power Plant Construction

Planned to be built, through utilization of medium coal and peat of local coal-dressing plants, are a pit-mouth power plant with a generating capacity of 2 million kilowatts and a new Zhaotong lignite power plant with a capacity of 3 million kilowatts.

### 5. Comprehensive Utilization of Coal

(1) Brown Coal: Because of its somewhat high moisture content which makes export uneconomical, brown coal will be used for power generation, gasification and comprehensive usage. For example, openpit mining is projected for adoption in the Xianfeng coal mine, Yunnan Province, where brown coal will undergo gasification for servicing Kunming Municipality, for producing methanol, or for making liquid fuel and organic chemical industry materials.

(2) Soft Coal: Soft coal, after going through a dressing and selection process, produces high-grade coal for smelting coke and medium coal or peat for generating power. Meanwhile, in compliance with the needs of the world market, coke or high-grade coal can be exported. Furthermore, in consideration of the very high proportion of coal and coke in the energy resources of Guizhou and Yunnan Provinces, of the need to reduce the burden on transportation, to increase capabilities of repaying loans, and to bring the utilization rate of coal into full play, it is proposed that one or two coke-smelting plants and one organic chemical industry plant be built in the two provinces.

(3) Hard Coal: Used primarily for making chemical fertilizers and blast furnace spraying powder, hard coal can be exported after going through a dressing and selection process.

6. In addition, projections call for cooperation with the various localities in construction of a number of medium and small enterprises, such as cement plants, glass factories, etc.

According to a preliminary estimate, the above projects require an investment of approximately \$1 billion.

### III. Open Door to and Cooperate With Foreign Countries

It has been a firm and steadfast strategic principle of China to open our doors to and expand our economic-technological exchanges with foreign countries in compliance with a principle of equality and mutual benefits. We must strive by all means to make use of some foreign capital funds that can be used for construction. In order to translate into reality our concepts for development of the southwest region, delegations were sent out in May 1982 to seven West European countries, where they visited government officials and chiefs of relevant departments of the various countries, made inquiries and entered into discussions with some corporations and consortia on forms of cooperation and loans for the southwest development projects, and signed a number of contracts respectively.

(1) A combined loans agreement, for use in technological reform of the existing southwest coal mines and railways and harbors, has been signed with the Technology Trading Company of Italy. The agreement has been approved by the government.

(2) A standby loan agreement of \$32 million was signed with Malta. The agreement has been approved by the government.

(3) An outline loan agreement of \$3 billion was signed with a consortium of corporations of Belgium, West Germany, Spain and France.

(4) A letter of intent for assessment and selection of one or two projects of joint venture, or for other possibilities of cooperation, was signed with General Electric Limited of England.

(5) Talks were started with a number of corporations in West Germany and the United States on development of brown coal in Yunnan Province.

(6) Contacts were made with Canadian corporation on development of brown coal and oil shale deposits on Hainan Island, Guangdong Province.

(7) Talks are continuing on the projected construction in Shenzhen Municipality, Guangdong Province, of a coal gas plant with a daily capacity of 1 million-plus standard m<sup>3</sup> for supplying gas to Shenzhen Municipality and Hongkong. Also planned to be built in Zhuhai County, Guangdong Province, is a coal gas plant for exporting gas to Macao.

(8) Also planned for construction are coal pipelines to facilitate export of coal.

To sum up, the five provinces (regions) of southwest China are very rich in energy resources and material resources and have plenty of projects requiring development. We welcome corporations and enterprises as well as economic organizations or individuals of foreign countries to take part in the southwest development undertaking.

## COAL

### OPENING OF EXPERIMENTAL COAL LIQUEFACTION PLANT HAILED

Beijing ZHONGGUO MEITAN BAO in Chinese 27 Apr 83 p 1

[Article by Sun Xudong [1327 2485 2639]: "Nation's First Experimental Coal Liquefaction Facility Now Operational; Heartening Achievement for Sino-Japanese Cooperation"]

[Text] On 21 April an inauguration ceremony was held at the Coal Sciences Institute to officially inaugurate China's first continuous experimental direct coal liquefaction facility, after successful trial runs. This is a joint achievement by both Chinese and Japanese workers based on an agreement for China and Japan to jointly develop coal liquefaction technology.

Minister of Coal Industry Gao Yanqwen and the director of the Japanese New Energy Development Organization [NEDO], Tsutomu Watamori cut the ribbon at the ceremony. President of the China Coal Society He Bingzhang [6320 3521 4545] and Tsutomu Watamori delivered speeches brimming with warm feelings. He Bingzhang said that putting this coal liquefaction facility into operation is the result of friendly cooperation between working personnel from both China and Japan, and is an encouraging step for China in developing comprehensive processing and use of coal. Watamori said, that the small-scale coal liquefaction continuous experimental facility is a seed of cooperation sown by the people of both China and Japan, and he hoped that through this cooperative enterprise the friendly relations between China and Japan will grow stronger.

The facility is set up inside the liquefaction building of the Coal Sciences Institute, and uses advanced second-generation coal liquefaction techniques. A small-scale experimental facility, it can process 100 kilograms of coal daily, and can produce 40 kilograms of liquefied product. The facility and liquefaction technology were provided by the Japanese. China is responsible for constructing the shops and for manufacturing and testing the equipment. The research achievements will be shared by both sides.

This direct continuous liquefaction test facility fills a gap in this area in China. After going into use we will carry out systematic experimental research on conditions of liquefaction techniques and liquefaction properties

of China's coal, raising the quality of processing of the liquefied product. Providing a technological basis for amplified tests and implementing industrial production from now on is one key item for China to tackle, belonging to strategic questions of scientific research.

Also present at the ceremony were responsible persons from the Chinese side, such as concerned departments of the State Planning Commission and the State Economic Commission, and responsible personnel of the Japanese Mitsui Group and Japanese Embassy officials stationed in China.

The Chinese and Japanese sides both expressed belief that this friendly cooperation will certainly yield positive results in the near future, and also will help develop even more widespread cooperation in coal work.

In additional news, on 20 April Minister Gao Yangwen met with the primary members of the Japanese delegation that came to China to participate in the ceremony, and both sides conducted intimate friendly discussions.

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CSO: 4013/228

## COAL

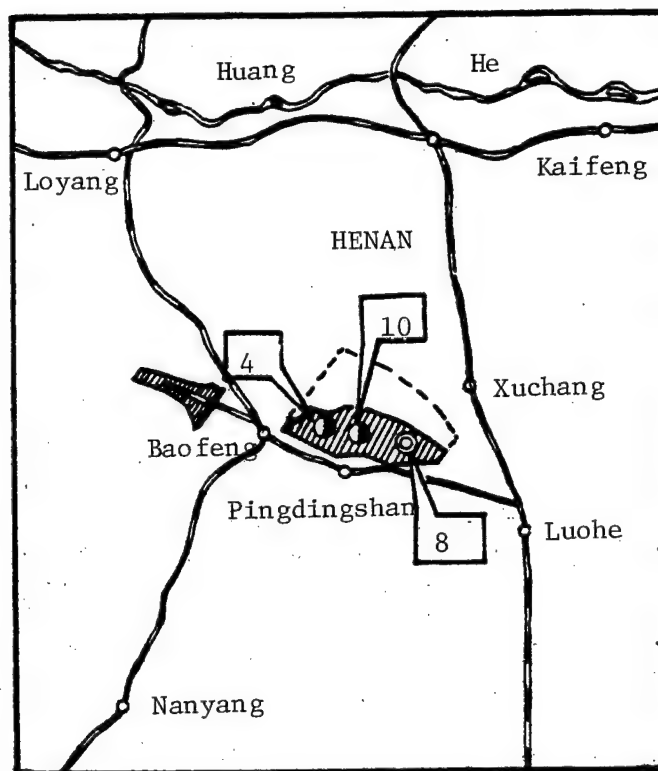
### NEW CONSTRUCTION, EXPANSION TO BOOST PINGDINGSHAN OUTPUT TO 3 MILLION TONS A YEAR

Beijing RENMIN RIBAO in Chinese 30 Jul 83 p 2

[Article: "Three Pairs of Large-scale Shafts Being Sunk, Expanded at Pingdingshan"]

[Summary] Work on the building and expanding of three large-scale mines at Pingdingshan is now being stepped up. The new "Ping-8" mines now under construction have a designed annual capacity of 3 million tons, and will be built in two stages. The first stage of construction was completed in 1981 and the second stage is now nearing completion. Transport, elevators, pumping facilities and other projects have been basically finished. Work on an associated large-scale pit-mouth coal dressing plant with an annual capacity of 1.8 million tons will soon be finished and it is expected that this plant will enter production along with the second stage of "Ping-8" by the end of 1984. The expansion of "Ping-4" and "Ping-10", the former with a capacity of 1.2 million tons a year, and the latter 1.8 million tons, to be completed in 1985 and 1986 respectively, will increase the capacity of each by 600,000 tons a year. Within 3 to 4 years, Pingdingshan will increase its raw coal output by 3 million tons a year.

Located on the eastern slopes of the Funiu Shan mountain range in Henan Province, Pingdingshan has a coal-bearing area covering 1000 square kilometers with geological reserves of 2.27 billion tons. The coal in this rich field is of high quality and can provide steam and coking coal for the iron and steel industry, the chemical industry, and the power generation industry. The Pingdingshan mining region has 14 pairs of shafts with a raw coal output capacity of 14 million tons a year, the major coal base in Central China. Pingdingshan now supplies coal to nine provinces in Central and East China as well as the city of Shanghai.



- Mine expansion
- New construction
- ▨ Producing field
- Surveyed field

CSO: 4013/298

## COAL

### TIEFA FAST BECOMING LIAONING'S LARGEST MINING AREA

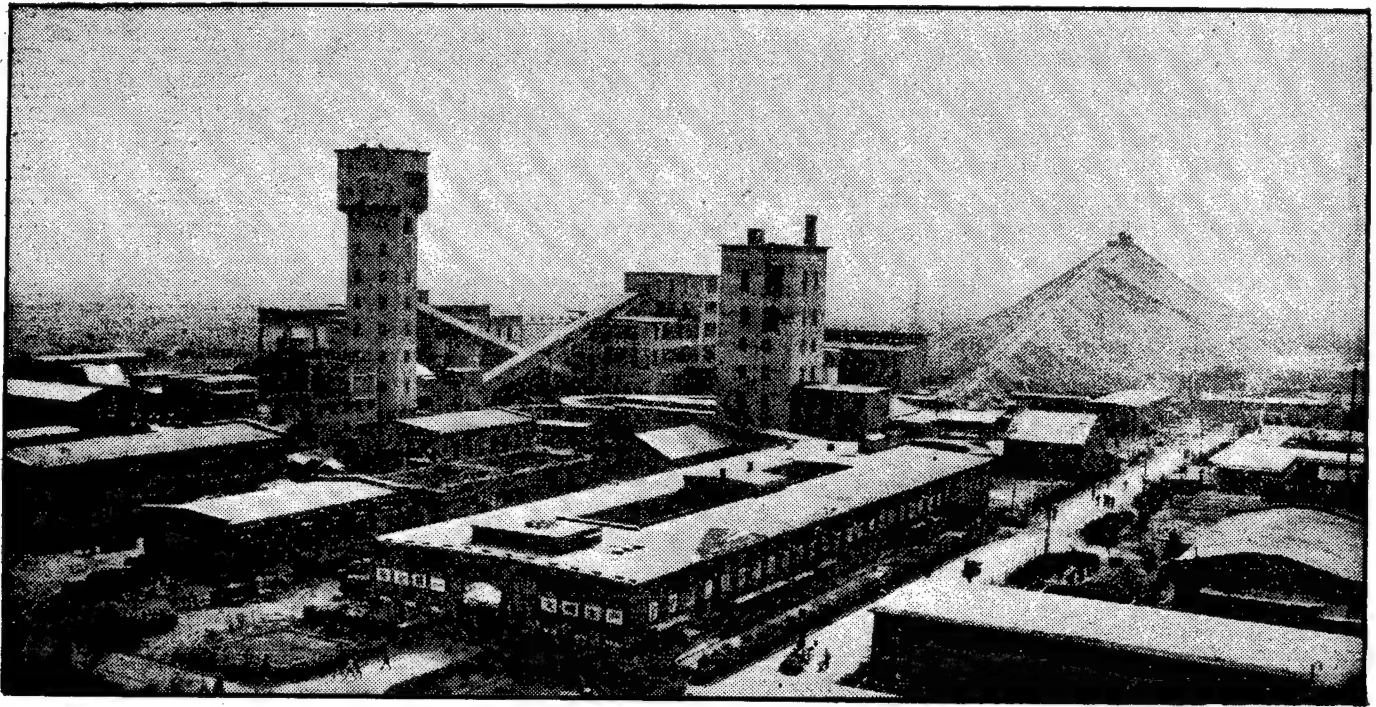
Shenyang LIAONING RIBAO in Chinese 12 Jun 83 p 1

[Text] The Tiefa mining area, one of 70 top-priority State projects, is tapping the latent potential of and transforming old mines and constructing new ones, continuously expanding production capacity. In 1982 coal production was .5 million tons more than in 1981 and this year it will continue to grow by .5 million tons for a total 1983 output of 3.0 million tons.

The Tiefa mining area stretches over Tieling, Faku, Kangping, and Changtu counties and the city of Tiefa. The coal resources here are rich, with proven reserves of 2.2 billion tons. Construction began in 1958 and now five dual shafts at Daming No 1, Daming No 2, Xiaoming, Dalong, and Xiaonan have been built. Coal production for 1982 was 2.6 million tons.

Since implementing the policy of national economic readjustment, the coal mining area has both transformed old mines and built new ones. The five producing pairs of mines already in operation are adding new mining areas, expanding the level of mechanized extraction, and overhauling such weak links as hoisting, transportation, and ventilation. Capacity will jump to 4.2 million tons by the end of 1984. At the same time, construction will begin on Xiaoqing, Daxing, Santaizi No 1, and Santaizi No 2. The Xiaoqing mine has a designed annual capacity of 1.2 million tons. The main and auxiliary towers and water towers of the above-ground [portion of the] project have now been built and most of the work on the coal dressing plant and the joint services building has been completed; two down-shaft extraction areas have been basically finished. Begun in the winter of 1980, the Daxing mine has a designed [annual] capacity of 3 million tons. As of the first half of this year, the mine had excavated 600 meters of the main shaft and 400 meters of the auxiliary shaft, nearly completing this portion of its work. The mine is expected to go into operation in 1989. The construction of the Santaizi No 1 mine, whose designed [annual] capacity is 1.2 million tons, will be started in 1984 and completed in 1989. Construction of the Santaizi No 2 mine will begin in 1985 and be completed in the "Eighth Five-Year Plan" period. Preparatory for the construction of these two mines is now in full swing. Through tapping latent potential, transformation, and new construction. The Tiefa coal mining area will boost its capacity by 600 percent over the current designed capacity by the end of the century. At that time, capacity will

have reached 16 million tons, or one-third of the province's total, making it the biggest coal mining region in Liaoning.



The Tiefa Mining Bureau's Xiaonan mine has achieved designed output in the space of only 3 years, a feat achieved by only a few of China's large-scale coal mines.

CSO: 4013/269

## COAL

### LIAONING LOCAL COAL MINES TO DOUBLE OUTPUT BY 1990

Liaoning SHICHANG ZHOUBAO in Chinese 17 May 83 p 1

[Article by Wang Xuanqing [3769 6693 1987]: "Local Coal Mining Continues To Develop, Output Will Double by 1990"]

[Text] "If such sectors of the infrastructure as energy and transportation are not developed, the national economy as a whole will not prosper and the individual sectors are bound to be greatly restricted in their development." (Excerpt from Comrade Hu Yaobang's report at the 12th Party Congress)

From the provincial coal conference which concluded on 14 May has come gratifying news: the local output of coal in our province will be doubled 10 years ahead of schedule.

The Ministry of Coal Industry has decided that with the improvement of economic results and conservation energy by society as the prerequisite, we should guarantee the quadrupling of the gross value of industrial and agricultural production by doubling our coal output so that by the turn of the century, the gross coal output will be increased from 0.6 billion to 1.2 billion tons.

For a long time, energy shortage has been one of the paramount problems restricting the national economic development in our province. Every year, the state has to supply huge quantities of coal from beyond the Great Wall. This supply not only fails to meet our needs but also causes a strain on the transportation facilities. Therefore, the conference decided that our local coal output had to be increased from 4.91 million tons in 1980 to 10 million tons by 1990, or 10 years ahead of schedule.

To ensure the attainment of this objective, the conference clearly set these future priority tasks: first, tap the resources of old mines in order to achieve a maximum increase in the productive capacity; second, step up the building of new mines and have 50 of them completed before 1990; third, adopt flexible policies to develop the coal mines of communes and production brigades to increase the total output to 4 million tons before 1990; and fourth, actively develop education and science and coordinate intellectual development with energy exploitation.

As the crucial year in achieving an output of 7 million tons in 1985 and 10 million tons in 1990, 1983 will mark the beginning of an all-out effort. The situation is fine as can be seen from the way the production plan for the first 4 months has been fulfilled. The planned output of nongovernment-controlled coal mines was 1,753,200 tons, and the actual output was 1,813,900 tons an excess of 60,700 tons.

The participants were full of confidence and pledged their contribution to doubling the coal output 10 years ahead of schedule.

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CSO: 4006/236

## COAL

### JOINTLY MANAGED ENTERPRISE FORMED OF STATE-RUN AND LOCAL MINES

Beijing RENMIN RIBAO in Chinese 15 May 83 p 1

[Article by correspondent Liu Qingbang [0491 1987 6721] and reporter Wang Biao [3769 1753]: "State-Run Wangzhuang Coal Mine Forms Joint Management With Small Coal Mines of Local Communes and Production Brigades"]

[Text] Wangzhuang Coal Mine under the Xinmi Mining Administration Bureau, Henan Province, has formed a jointly managed company with the small mines of nearby communes and production brigades. By this means, it has helped solve the long-standing problems of funds, technology, equipment and marketing among these small mines to a certain extent, and also promoted the development of the local coal industry.

The principle behind this joint management is to bring into play the strong points of each party and to learn from and help one another on the basis of equality and mutual benefits. Wangzhuang Coal Mine is to be responsible for the funds, equipment and technology required for the development of small coal mines, and will own three of the five shares, while the communes and production brigades supplying land and labor will own the remaining two shares. During the coal mine's regular operation, the profits or losses will be divided according to the number of shares. The funds have been raised by the workers and staff members through voluntary subscription, and in the case of loss, Wangzhuang Mine will pay both the principal and interests. The wages for the laborers of communes and production brigades will be paid by the joint company on a piecework basis, and the dividend on the land will be rationally distributed by the production brigades.

This joint company, formed 3 months ago, has already demonstrated its superiority in the following respects:

1. It does not require any state investment. Along with the improvement of the state's economic situation and the adoption of the system of responsibility for management among the mines, the workers' income has been greatly increased, and they are glad to invest their money to support national construction. In less than 1 month, they raised 170,000 yuan.
2. It solves the problem of technology among the small coal mines. Previously, the small coal mines of the communes and production brigades operated more or less "at their own convenience" with serious waste of labor and time. After

the joint management, Wangzhuang Mine dispatched its engineers to assist in prospecting, surveys and designs. Many problems difficult for the small mines were quickly solved by these engineers.

3. The supply of equipment and materials was guaranteed. After Wangzhuang Mine's transformation and expansion, its small sets of equipment suitable for small mines were left idle. Now they are being used to good advantage. Some small railings, small transformers and small trailers are now playing important roles in production in these small mines.

4. It shows quick results. The Yutai Mine suspended operations for lack of funds and materials, but was able to resume coal production within 2 weeks after the jointly managed company was formed.

5. It helps to clear the channels of marketing. In the past, the small mines experienced difficulties in producing coal and even greater difficulties in selling it. Now Wangzhuang Mine is solely responsible for sales and the small mines need no longer worry on this score. In slightly more than 2 months after the founding of the joint company, these small mines sold 8,500 tons of coal abroad through the company.

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CSO: 4013/236

## COAL

### ISSUE OF MINE SAFETY HIGHLIGHTS NATIONAL CONFERENCE

Beijing ZHONGGUO MEITAN BAO in Chinese 4 May 83 p 1

[Text] The National Mine Safety Inspection Conference ended on 2 May in Beijing. The conference tackled the problems that exist in mine safety production, according to the directives of leading comrades of the party Central Committee and the State Council on mine safety problems, analyzed causes and lessons, and studied urgent measures to do a good job of mine safety and production now.

On the morning of 30 April Comrade Wan Li [8001 6849] representing the party Central Committee and the State Council addressed the whole body of comrades attending the conference, and pointed out the directives on developing the coal industry and doing a good job in mine safety production. He said: "The results of the plan for the national economy and social development for 1982 have been published, national coal output reached 666,000,000 tons, the highest level in history. Last year, mine safety reached its best level in several decades. This is the result of a joint effort by the personnel under the leadership of the Ministry of Coal Industry and regional party committees and local government at all levels. On behalf of the party Central Committee and the State Council, permit me to express greetings and thanks to you and all the staff and workers on the front line of the coal industry. Thank you for making a great contribution to the country and the people."

He also said: "The coal industry plays an important role in the national economy. Without you, many other industries could not work. China is a big country, and the amount of energy we need for modernization is enormous. From the conditions in China we can see that energy is primarily dependent upon coal. You must clearly understand the big picture, raise the sense of glory and the sense of responsibility of the coal industry, and by every possible means raise coal production. The coal industry must 1) have safety in production; 2) increase output; and 3) satisfy the needs of the nation and the people."

Comrade Wan Li pointed out: So far this year, mine safety conditions have not been good. We must resolve this by adopting strong measures, primarily by enforcing the policy of "safety first." This must be said day after day, year after year; safety work must be given top priority. Second, we must resolve

such problems as safety technique measures, survey testing means, and facilities. Third, we must strengthen management, raise standards and tighten requirements, and strictly implement ordinances and rules and regulations. Only if we grasp basic work can we then take preventative measures. Fourth, we must train safety technicians to the staff members and workers, strengthen safety education, and achieve standards of knowledge and capability. Fifth, from the Ministry of Coal Industry to the provincial mining bureaus, emphasis should be placed on improving the management of small coalpits and stress placed on safety training and technology. Sixth, we are now in the process of implementing economic reforms in coal, and this must not affect either safety or production.

Comrade Wan Li especially pointed out: We must fully develop the supervision and inspection function of the workers. When situations occur in production that endanger the lives and safety of the workers, the workers may propose suggestions either in group meetings or directly to the administrative leadership, and demand solutions. If unheeded, they should again issue a warning, and in group meetings should mobilize the workers to urge the administrative leadership to adopt measures to resolve the safety problems. If again unheeded, the worker may refuse to report for work, with full wages, returning to work only after the problem is resolved. The coal industry cannot just have "Safety Month" [once a year], but must have safety every day year after year. What is the point of having safety one month and not the next?

The comrades attending the conference earnestly studied the important directives of leading comrades of the party Central Committee and the State Council and the speeches of leading comrades of the State Economic Commission, the State Planning Commission, and others, relating what was said to the realities of the coal industry, analyzing accident cases, and learning from both positive and negative experiences. On the basis of the collective wisdom of the masses, Comrade Gao Yangwen, representing the ministry and leading party groups, summarized the primary lessons learned from experience in mine safety, pointing out 11 urgent measures to bring safety work into a new phase: 1) Earnestly put the policy of "safety first" on a solid base; 2) Do a good job in May on "safety month" activities, and promote safety inspections; 3) Resolutely prevent and control accidents involving gas and coal dust explosions; 4) Take necessary precautions to prevent major accidents; 5) Establish the system of job responsibility in safety and implement professional work to ensure safety; 6) Strengthen the legal system and economic sanctions; 7) Reorganize safety structures and units and fully develop the role of specialized personnel and safety personnel holding concurrent posts; 8) Train units and improve technical quality; 9) Do a good job in regional mine safety work; 10) Resolutely control pneumoconiosis; and 11) Raise the level of equipment and implement scientific administration.

This conference made everyone deeply aware of the fact that the party Central Committee and the State Council are extremely concerned about safe mine production, and further heightened the sense of urgency and the sense of responsibility to do a good job in mine safety and production. It was unanimous: "Producing a lot of coal will ensure the four modernizations." This is the

glorious mission that history has bestowed upon the staff members and workers in the mines; the burden on these people is heavy. The heavier the task, the more important it is to concentrate on safety. We must turn the intimate concern of the party Central Committee and the State Council into a great force, turn the lessons learned from experience into wealth, rouse our spirits and enthusiasm, implement all safety measures, and vigorously start a new phase of safe production.

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CSO: 4013/228

## COAL

### PROGRESS OF COAL GEOLOGICAL SURVEY WORK

Beijing ZHONGGUO MEITAN BAO in Chinese 27 Apr 83 p 2

[Text] Coal geological survey work, seriously disrupted during the 10 years of catastrophic upheaval, has quickly rebounded in recent years. In the past 2 years, surveys for producing mines explored footage of 1,200,000 meters, 12 billion tons of newly proven reserves (including improved reserve levels) and 6,000,000 tons of coal remnants have been found in old areas, and 136 geological reports have been submitted for opening mines and extending the depth of mines. Under the guarantee of geological survey work, from building the construction of water structures and railroads, we have mined more than 40 million tons of coal, completing more than 20,000 large-scale valuable through projects. More than one-third of the prospected footage that was short over the years has already been repaired. At the National Coal Geological Survey Conference held recently, they summed up the achievements of geological survey work and proposed that be strengthened.

In the last few years, many geological structures of mines have been restored, troops are continually replenishing, and there are 1,300 more technicians than there were in 1980. Each area also has conducted geological survey courses to train 324 classes, training 36,430 people. Foundation work is gradually becoming stronger, rules are being revised and drawn up for mine geology, open-pit mine geology, hydrogeology and management of reserves. Rules and regulations are being reorganized and amplified, and the confused phase of geological survey work is beginning to turn around.

The technical and equipment levels of geological surveying have improved. The application of new technology to carry out geological research on mines is now beginning; mathematical geology methods and electronic computers are beginning to be widespread and photo-electric range-finding, gyroscopic theodolites, and laser direction finding have developed. Water for mines and three-dimensional photography for mine geology are beginning to be tested for use.

But present geological work in coal mining is still rather weak. First, organization is not sound and there are not enough technical personnel. Geological survey structures for some of the deposits still aren't built, a

technological backbone is lacking, hydrogeological personnel are extremely few, leadership is weak, and technological management is backward. Second, technological foundation work is lacking. Shortage of prospect footage and area surveys is very great, and many basic mine charts badly need to be redrawn and repaired. Third, technical means are backward. Many units still use old style drilling machines and old style surveying instruments, mine geology still remains in the stage of the compass, hammer, tape measure and magnifying glass.

How can we begin a new phase in coal geological survey work? The conference proposed that we must do a good job in self-building of geological survey units, vigorously train people of ability, and depend on science and technology to develop geological survey work. We must strengthen leadership and improve understanding of geological survey work. Geological surveying is the "eyes" of coal production, the advancing of all construction. Geological survey work achieving good or bad directly influences the development and results of production. To develop mechanization, especially comprehensive mining, we even more need geological forecasts that are prompt and accurate. Therefore, this year, aside from ensuring the daily production construction needs, geological survey work must stress grasping well long-term plans and plans to make up for what is lacking, strengthen technical foundation work, positively promote advanced techniques, and urge forward the development of coal production.

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CSO: 4013/228

COAL

BRIEFS

SEMI-ANNUAL COAL QUOTA EXCEEDED--Beijing, 27 Jun (XINHUA)--China has produced 325.57 million tons of coal up to today, fulfilling the semi-annual quota 4 days ahead of schedule, according to the Ministry of Coal Industry. China's mines produced 17.27 million more tons of coal than in the same period last year, a ministry spokesman said. The statistics of coal mines operating directly under the Ministry of Coal Industry shows that from January to May, per unit area yield of the coal faces increased by 3.8 percent while coal ash was reduced by 0.52 percent. [Text] [Beijing XINHUA in English 1123 GMT 27 Jun 83 OW]

NEW XINJIANG COAL FIELD--Urumqi, 30 Jun (XINHUA)--A coal field with verified reserves of 60 million tons has been discovered in Buya, in southern Xinjiang Uygur Autonomous Region, the regional geological bureau announced today. A highway is being built from the city of Hotan, 120 kilometers to the south, to Buya in preparation for sinking coal shafts, the bureau said. Hotan, a famous jade-producing area, lies along the southern fringe of the Taklimakan Desert and has traditionally suffered from acute energy shortages. [Text] [Beijing XINHUA in English 1338 GMT 30 Jun 83 OW]

CSO: 4010/82

## OIL AND GAS

### PREDICTIONS ON PETROLEUM DISTRIBUTION AND PROSPECTS IN EAST CHINA'S CIRCUM-PACIFIC REGION

Beijing SHIYOU KANTAN [PETROLEUM EXPLORATION AND DEVELOPMENT] in Chinese No 2, 1983 pp 1-7

[Article by Hu Jianyi [5170 6015 5030], Gan Kewen [3927 0344 2429] and Xu Shubao [1776 2885 1405] of Scientific Research Institute of Petroleum Exploration and Development, Ministry of Petroleum Industry: "Some Ideas on Petroleum Distribution and Prospects in East China's Circum-Pacific Region"]

#### [Text] Abstract

The Circum-Pacific Region of east China has become a major world oil-producing region. The formation of oil and gas was mainly controlled by the occurrence of faulted depression basins affected by Late Mesozoic-Cenozoic tectonic systems in the Circum-Pacific region. The region is divided into three sections, i.e., north, central and south. Most basins originated from Tertiary tensile faulting, and there are three trap models. The distribution of oil and gas pools was controlled by olefiant centers of the Paleogene period.

The authors believe that many oilfields will be found in faulted depressions waiting to be explored, and more stratigraphic and lithologic oil pools will be found in basins which have already been intensively explored. There are some prospects in continental saliferous basins, and potential target strata may be found in the underlying strata series of faulted depression basins. Offshore sedimentary basins also hold good oil prospects if we compare their growth characteristics with the preceding type of basin.

#### Introduction

Decades of exploration have proven that ours is a country with rich oil and gas resources; approximately 90 percent of our crude oil is found in the Circum-Pacific Region located east of the line running through the Daxingan Ling, Taihang, and Wuling Mountains. The tectonic movement since the Mesozoic era in this region reflects the impact of Circum-Pacific tectonic crustal and mantle movements (1). Departing from the tectonic background of this region, this paper will examine the distribution of oil and gas fields, and present some ideas on the prospects of exploration.

## I. Regional Geological Background of Continental Basins With Known Oil and Gas Pools

Under the impact of the Pacific tectonic system from Late Mesozoic to Cenozoic eras, many continental faulted depression basins developed in the eastern part of the Chinese continent extending from Songliao in the north to Beibu Gulf in the south. These basins were conditioned by the old tectonic system of the Paleozoic era; in other words, due to the property differences in the Pre-mesozoic basement, there are remarkable gaps between the southern, northern and central sections.

1. Northern Section: Located north of Shenyang, the basement is primarily part of the Hercynian fold system. Superimposed on top, the gigantic Songliao Basin experienced intensive subsidence due to tensile blocking which occurred from late-Jurassic to the beginning of Early Cretaceous Period; it began to rise at the end of the Late Cretaceous Period, and collapsed in the Cenozoic Period. Songliao Basin's Daqing Oilfield is at once China's largest oilfield, and the largest land-facies oilfield in the world. From late Early Cretaceous to early Late Cretaceous, the oilfield's structural setting was a river deltaic system extending from north to south into the water body of a lake basin (2). The excellent olefiant and reservoir factors provided adequate material basis for the formation of the giant oilfield.

2. Central Section: The basements south of Shenyang and north of Changsha-Nanchang are platform systems, and the Qinglin Fold Belt is sandwiched between the two platform systems. Faulted depression basins are distributed in this area, which is characterized by Early Tertiary rifting and Late Tertiary subsidence. Part of the underlying strata in the region have Late Mesozoic graben basins. Although it is universally recognized that there are potential olefiant beds in the Upper Mesozoic strata, it is also known that oil and gas accumulations are mainly related to the dustpan shaped olefiant depression controlled by Early Tertiary rifts (3,4). What merits our attention is that underneath such vast alluvial plains as North China Plain and Subei Plain are numerous depressions of this category, but only a handful of them have been extensively explored, and many important oilfields, even large ones have been found. The oil and gas pools in the basins of the North China Platform region in the north are richer than the same type of basins of Yangzi Platform in the south.

3. Southern Section: Situated south of Changsha-Nanchang, its basement is south China's geosynclinal folded region characterized by active Mesozoic magmatic movement, and small and underdeveloped late Mesozoic-Cenozoic faulted depression basins. The Late Tertiary subsidence is also limited, and small quantities of oil flows can only be found in individual basins today.

## II. Basic Characteristics of Oil and Gas Distribution and Oil Reservoir Models

The eastern portion of the Chinese continent was totally consolidated and hardened by the Hercynian movement. Following the Indosinian movement, the eastern edge collided with the cratonic plates, causing the mantle in the depths of the region to upwarp, and giving rise to volcanic and magmatic

activities, which led to the formation of volcanic arcs. Emerged against this background were Late Mesozoic graben-type rifted basins characterized by interarc basins, often including developed intermediate volcanoes and pyroclastic rock systems. In the course of development, the volcanic arcs continuously shifted eastwards; by the Cenozoic Period, it had reached China's Taiwan, the edge of the East China Sea continental shelf, and Japan. By this time, the entire area had been transformed into a cratonic region. Thus, rifted basins which had formed since the Tertiary Period are characterized by intracratonic rifted basins accompanied by occasional basic basalt flowage in the early period. It is worth noting that in the late development stage, this type of basin went through two developmental stages, i.e., rifting and sinking, which was attributed to the cooling of deep mantle materials and subsidence of geosynclinal areas (5). In view of the significant link between basin evolution and oil/gas enrichment conditions, we have named this group of basins "faulted depression basins." The sedimentation of the basins in the early period and the main faults occurred simultaneously against the background of regional unwarping, and [the basins] were often starved. This characteristic determines whether the main oil formation period was during the rifting period (North China) or regional sinking period (Songliao). During the downcasting phase of the late growth period of the basins, due to the isostatic compensation of the earth crust, vast stretches of surrounding mountain areas began to elevate, and there were adequate supplies of fragmental materials. However, most of the sedimentation occurred in flooded alluvial plains, and most lacked conditions for oil formation/reservoir conditions. But they were essential for promoting the maturation of underlying olefiant beds. Based on analysis of fairly well explored areas of the North China Region, we find the following characteristics:

1. Most faulted depressions (mostly dustpan shaped) have formed their own olefiant centers.

2. Each olefiant center controls the distribution of oil and gas pools.

3. Enriched zones of oil/gas fields have formed around the olefiant centers and within trap zones which had evolved during the maturation period of the source rocks. The basic models of the oil/gas traps of the enriched zones are classified into three categories according to contributory factors.

- (1) Enriched models consisting of growth faults accompanied by reverse drag (rotational) structures and anticlinal structures caused by arching of plastic strata. The relation between the former type of structure and oil/gas accumulation is common knowledge. The latter type is a special product of faulted depression basins. Large covered arenaceous rocks or evaporites which had formulated through starved sedimentation during the rifting and developmental phases of the basins were less compact strata under the load of overlying strata; under the impact of paired partial pressures due to horizontal compression caused by the downward motion of the main faults on the steep sides of the dustpan shaped faulted depressions and the down side motion along the gently inclined sides, the central area became thicker and gave rise to changes similar to the plastic deformation of salt upwarps or shale ribs, causing the overlying strata to arch upwards into anticlinal structure accompanied by

"cabbage"-like compound graben faults. This type of structural oil and gas zones are distributed in the depths of depressions with the planes located near the steep sides; they are characterized by high degree of oil and gas enrichment, and the percentage of successful explorations is also high, e.g., Dongying and Dongpu Depressions.

(2) Draped anticlinal and overlapping unconformity enriched models. In faulted depression basins, oil and gas accumulation sites developed from draped structures of overlying sedimentation which had formed from inclined block faults, e.g., Zhanhua Depression. High-yield Qianshan oil pools, such as those in Raoyang Depression, could have developed when the Pre-tertiary basements of the inclined faulted blocks were mid/upper Proterozoic or lower Proterozoic carbonatites or strata with excellent porosity which had undergone long term eluviation and corrosion, or became overlapped by Lower Tertiary source rocks, or became juxtaposed with olefiant centers.

(3) Stratigraphic-lithological oil pool enrichment models. Due to the intermittent development of faulted blocks in the course of subsidence and their cyclic sedimentation, many finger cross beddings of varying phases and overlapping pinch-outs often occurred on either side of the dustpan depressions, especially in gentleslope regions, thus forming stratigraphic-lithological trapped oil pools, e.g., Liaoxi Depression.

### III. Ideas on the Prospects of Exploration on Land Regions

Through exploration, a fairly large amount of deposits have been discovered in the eastern part of the Chinese continent. But there is one problem that has caused much concern and should be examined, i.e., whether or not there are more potential deposits to be discovered.

1. Large numbers of faulted depression basins yet to be explored. What we now know as North China-Bohai Gulf Basins are, in fact, basin zones composed of many Early Tertiary faulted basins (depressions). To this day, the only ones that have been fairly well explored are those which are relatively large and outstanding; there are still a multitude of faulted depression basins awaiting to be explored. Inside these basins, the enrichment of oil and gas depends on the amplitude of faulted depression, and not on the size, e.g., in the eastern part of Nannang Basin, rich deposits have been found in the Miyang Depression although it measures only 1,000 square kilometers (4).

2. In fairly extensively explored faulted depression basins (depressions), stratigraphic-lithological traps are prospective targets worth exploring. Structural oil pools of large sizes and amplitudes with considerable yields and deposits have been found in well-explored basins. Besides, a number of very potential stratigraphic oil pools have been found; the theoretical basis lies in the possibility that a series of varying types of stratigraphic-lithological traps could have developed as the result of the diversity of fluviolacustrine sedimentary sand bodies under conditions where land facies faulted depression lake basins experienced frequent water invasions and recessions. Recently, in Shengli Oilfield's Dongying Depression, five

stratigraphic-lithological oil pool zones were found through preliminary survey; it is estimated that their geological deposits could account for more than 20 percent of the total geological deposits of the depression. Based on the prediction, such oil pools are mainly stratigraphic traps and relatively difficult to find; their potential deposits may amount to a sizeable proportion of the total reserves in other well-explored faulted depression basins.

3. The important potentialities of oil/gas Tertiary (Paleocene-Eocene) inland saline lake sedimentary basins. A considerable portion of the numerous faulted depression basins in the eastern part of the Chinese continent have Tertiary evaporite strata containing hard gypsum, rock salt, and some carbonatite, which are chiefly amassed in the lower portion of Tertiary strata and geographically distributed south of 40 degrees North Latitude. Just as in the evolutionary history of many intracratonic faulted depression basins around the world, due to inadequate feeding of faulted depression basins during the early-period run-off stage, the saline deposits formed into evaporite strata under conditions where the fragmentary deposits could not make up the subsidence and the climate was dry to semi-dry. We believe that this characteristic is related to the rifted formation's rate and amplitude of subsidence during the early stage, and the evaporite strata often existed in depression centers which sank relatively fast. The Qianjiang Depression's evaporite sedimentation sank at the rate of 0.29 mm each year (6). Such faulted depressions are relatively well developed in the central section of faulted depression zones, e.g., North China's Dongying, Dongpu, Jiangxian, etc, as well as the Chang Jiang River Basin's Jiangnan, Hengyang, Wuhu, and Changzhou. Saline lake sedimentary basins are also found in the southern section, e.g., Guangdong's Shanshui, and Dongwan. The upper and lower land facies evaporite deposit strata are rather unique in that they are often elephant beds of well-developed stillwater lacustrine facies shales (oil-shales). Moreover, due to the cyclic property of evaporite deposits, interbeddings of elephant beds and evaporites have been formed. Based on studies on Dongying, Dongpu and Jiangnan Qianjiang Depressions, it has been proven that the evaporite deposits of such small-size land facies faulted depression basins are not only conducive to oil and gas formation, but also to oil and gas accumulation and preservation.

In the past, we used to emphasize exploration of oil and gas pools above evaporite systems with excellent results. Based on the patterns of evaporite sedimentation, it is also necessary to study elephant conditions below evaporite strata, as well as the potential oil and gas accumulations in underlying stratigraphic faulted blocks. Besides, the currently discovered oil and gas fields and developed saline basins only account for a minority group. Further efforts have to be put into studying the prospects of other saline basins.

4. Probe into the oil and gas bearing properties of the underlying strata of Cenozoic faulted depression basins. Among the oil and gas bearing basins in the eastern part of the Chinese continent, except for Cretaceous pay beds of Songliao Basin in the northern section, the pay beds in other basins are primarily Tertiary. Some pre-Tertiary pay beds actually resulted from the lateral migration and accumulation of Lower Tertiary oil and gas, e.g.,

Mesozoic fragmentary rocks and volcanic rocks, and high-yielding Paleozoic and Sinian Suberathem carbonatites. But this paper will look into the possibilities of commercial oil and gas accumulations formed in underlying Pre-tertiary strata. Based on what we know today, there are three series of strata with different prospects:

(1) Oil and gas bearing beds in underlying Late Mesozoic graben-type faulted depression basins. Olefiant beds measuring more than 500 meters thick have been found in some places inside Upper Jurassic-Lower Cretaceous graben-type faulted depression basins located in Bohai Gulf and adjacent areas. The olefiant beds contain 0.8-1.12 percent organic carbons, 550-940 ppm hydrocarbons; the oil source threshold depth is 800-1,200 meters; OEP value is 0.81-1.09; the main peak carbon of normal-paraffin hydrocarbons is C14-19. In the shallow wells of Late Mesozoic basins which have no Cenozoic overlying strata, excellent indications of oil and gas have been found (3). Thus, it is predicted that the underlying Mesozoic strata in Cenozoic basins are potential targets for exploration.

(2) There are great prospects for coal gas pools. In the eastern part of China, coal-bearing structures are distributed among Permo carboniferous series and Upper Triassic to Lower Jurassic series. Carboniferous-Permian coal is classified as platform sedimentation characterized by stable and extensive distribution. The authors believe that coal gas is natural gas formed from organic substances scattered in coal seams and argillaceous rock formations within coal systems. It is quite possible that the natural gas became gas pools under overlying Tertiary deposits. Recently, block-faulted unconformities between Tertiary based sandstones and Triassic-Permian carboniferous systems were formed beneath Dongpu Depression's Wenliu salt dome structure. The carboniferous coal seams are 4,500 meters below the surface; the vitrite reflectivity is 1.5, which falls within the classification of coking coal. The Tertiary sandstone is located at the depths of 3,000-3,500 meters; commercial gas pools were formed under the overlying evaporite strata; analysis of the gas samples indicate 95-99 percent methane, and approximately -25 o/oo isotopic carbon  $\delta C^{13}$ , which is quite different from oilfield accompanying gas which has 80 percent methane and -35 o/oo isotopic carbon  $\delta C^{13}$ . Thus, it is believed that the gas in question is Permo carboniferous coal gas.

(3) Sea facies target strata are also promising sites of exploration. The southern half of the eastern part of mainland China includes the southern portion of the central section and the southern section. Beneath the Mesozoic-Cenozoic basins are well-developed Early Mesozoic and Paleozoic sea facies sediments primarily composed of carbonatites. Fairly extensive showings of oil and gas are found in these overlying strata located on Yangzi Platform and South China's Caledonian folds. Due to Indosinian cyclic and Yanshan cyclic transformations, the strata exposed at the surface are fairly fragmentary and lack proper conditions for sealed preservation; thus, only a few buckets of oil flows were struck here after fairly long period of surveying and exploration. Based on the experiences of Europeans in the exploration of some basins, such as the Po Basin [sedimentary basin in Italy] and the Vienna Basin, it is possible to find oil and gas fields in overlying late Mesozoic-

Cenozoic faulted depression basins with underlying sea facies carbonatites which had undergone tremendous changes. Not long ago, in the mid-Cenozoic Jurong Depression of Jiangsu Province, oil flows were struck in underlying Triassic sea facies Qinglong limestone, thus indicating the potentialities of underlying sea facies strata.

#### IV. Analogical Evaluation of Offshore Basins

The coastal seas along the eastern part of China include the Bohai, the Yellow Sea, the East China Sea and the South China Sea. A wide continental shelf and extensive area of predominately Cenozoic sedimentary basins lie in these coastal seas. They belong to the northwestern part of the Circum-Pacific (Pacific System) which is characterized by a series of open bow-shaped marginal seas situated within the volcanic arc. At present, there are a lot of disputes concerning the genesis of these marginal seas. Based on the theory of plate tectonics, it is generally believed that the tension interarc basins became oceanic crusts as the result of continental separation. It is also believed that the marginal seas were formed from past land blocks due to crustal submergence or oceanization. We hold that both of these factors could have been contributory in view of the fact that samplings from the floors of both the Japan Sea and Philippine Sea prove the existence of portions of fairly old continental crusts. Besides, the volcanic arc on either side of the marginal sea are not from the same period, i.e., the volcanic arc on the side of the continent is older than the one on the side of the Pacific Ocean, which indicates that the volcanic arcs are shifting with time. Samples from the deep sea and offshore drilling data prove that the Tertiary formations in the Japan Sea (7), East China Sea, and the margin of the South China Sea are all land facies deposits, which means that during the Early Tertiary Period, the formations west of the Japanese Islands [Nippon Retto], Ryukyu Islands [Ryukyu Gunto], China's Taiwan and the Philippines were continental basement tension faulted basins, while those in the east side were marine facies geosynclinal region. During the Late Tertiary Period, the marginal zone of the East Asian continent underwent rifting and subsidence, and became a marginal deep-sea basin. At the same time, there were landward inundations. Based on the fact that volcanic arcs exist in the central and northern sections of Ryukyu Islands, and the basement consists of Miocene-Pliocene volcanic rocks and Oligocene littoral deposits (8), it is conjectured that the margin of the East China Sea continental shelf extending north-eastward from the northeastern corner of Taiwan through Diaoyu Island [Diaoyu Dao] to Goto Islands [Goto Retto] could be part of an Early Tertiary volcanic arc which had separated in the east from the Ryukyu Islands while the central section expanded and sank, thus forming the Okinawa Marginal Sea Trough. The South China Sea is also a marginal sea.

Marginal seas, otherwise known as minor oceanic basins, are surrounded by different kinds of basins. The ones that are near the continent are classified as continental marginal basins, such as the mouth of the Zhu Jiang [Pearl River]. Those which are situated at the margin of volcanic arcs should be classified as orogenic belt type basins or basins in the geotechnic suture belt, such as the Okinawa Trough. The Upper Tertiary System

of the East China Sea Basin is characterized by seaward sedimentary growth and should be classified as continental margin subsidence basin; the underlying Lower Tertiary System may still have the properties of inland faulted depression basins.

Bohai and South Yellow Sea are landward marginal sea extensions of continental faulted depressions and most inundations occurred only in the Quaternary Period. Thus, they should not be regarded as continental margin basins.

Based on the relation between sedimentary basin types and oil/gas accumulation, we have conducted analogical evaluations of the prospects of oil/gas-bearing coastal sea basins.

1. Bohai Region: This is part of the North China-Bohai Gulf Basin with the Liaohe, Dagang, and Shengli Oilfields in the north, west and south; it is definitely an oil/gas region of commercial value. The eastern half of the basin is known as Tanlu Faulted Belt which is a Cenozoic tension faulted zone with right lateral displacement properties. Based on the impact of tension-torsion faults on deep depressions and growing anticlinal structure, it is conjectured that the long-range prospects of this region are comparable with land prospects. This is illustrated by the recent completion of high yielding oil wells.

2. South Yellow Sea Basin Region: This is the seaward extension of land-based Subei Basin. Oilfields have already been discovered in Subei, which indicates that the region is prospective. Although Subei Basin is not so well explored as North China Region, in view of the fact that the basin has Early Mesozoic and Paleozoic developed marine facies sedimentary strata, and the changes among its overlying strata are weaker than North China's, it is believed that major breakthroughs could very well happen in the future.

3. East China Sea Basin: The long-range prospects of the East China Sea Basin should be viewed from two seats of strata, i.e., first, the distribution of underlying Lower Tertiary faulted depressions; second, the thickness of overlying Tertiary system. According to available information, both sets of strata are growing thicker eastward. It is conjectured that the basement is chiefly composed of Late Mesozoic volcanic rocks, Yanshan magmatic rocks, and metamorphic sedimentary rocks. Based on seismic data, we believe that the unchanged layers on top are from Quaternary to Pliocene; the middle portion's slightly folded layers are Miocene; the bottom portion's tension fault block layers are Lower Tertiary, and may also contain some Upper Mesozoic sedimentary rocks. But the basement in the eastern half of the basin is even more likely to be Lower Tertiary volcanic Rocks. It is worth noting that some seismic profiles indicate that Lower Tertiary normal faults extended upwards to Miocene strata and transformed into reverse faults, thus reflecting the impact of landward compression during the Late Tertiary Period, or the possibility of accompanying left lateral displacements similar to Taiwan region. Based on what little drilling data we have, the Upper Tertiary in this region is mainly land facies while the late period was affected by inundation. Based on this geological characteristic, we believe that the East China Sea Basin is similar to Indonesia's Sumatra and Jawa Basins, except

for the fact that it is primarily composed of land facies deposits. It is conjectured that this region holds fairly good oil and gas prospects, especially the deep downthrown areas in the eastern half of the basin which not only has well developed anticlinal belts with excellent trap conditions, but also elevating geothermal flux values possibly caused by neighboring volcanic arcs, which is conducive of olefiant bed maturation and migration.

4. Southern Coastal Sea Basins: This region includes the mouth of the Zhu Jiang, Beibu Gulf and Yinggehai Basins. Although the Early Tertiary faulted depressions are similar to North China, due to the fact that the Late Tertiary land-bordering marginal sea has well developed overlying marine inundation sedimentary layers, its oil formation and reserve conditions are much better than the alluvial strata in the North China Region. Thus, the evaluation for this region is better than the North China Region. But there are slight gaps between the preceding three basins owing to the difference of their positions. Beibu Gulf and the mouth of the Zhu Jiang are typical faulted depression type passive continental marginal basins; due to Early Tertiary faulting, they were separated from the continent in the Late Tertiary period and sank; the Upper Tertiary System is classified as continental shelf terrigenous clastic deposits. Yinggehai Basin is situated at the margin of the deep sea and, to a certain extent, is similar to seaward growing delta type continental marginal basin, except that due to inadequate terrigenous clastic sedimentation, there are reef facies deposits in the shallow spots, and mud-pierced structures which had developed from deep-sea ooze have been found in the deep parts of the basin.

In sum, based on known oil and gas distributions, plus some indications discovered in the course of exploration, and through the analogical evaluation of the basins, we firmly believe that excellent prospects await oil and gas exploratory efforts in East China, whether it may be on land where major achievements have already been attained, or coastal seas where large-scale exploration has just begun.

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## OIL AND GAS

### CLASSIFYING THE TYPES OF GAS POOLS IN CHINA

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[Article by Dai Jinxing [2071 6855 2502] and Qi Houfa [2058 0624 4099] of the Research Institute of Petroleum Exploration and Development: "Classification of the Types of Natural Gas Pools in China"]

[Text] [Abstract] Gas pools already discovered in China have been divided into three groups and seven types on the basis of actual data on China's gas fields and gas deposits and according to the function, significance and primary and secondary relationship between structure, geostrata, lithological character and paleoweathered crust in the formation of traps and gas pools, i.e., structural gas pools, lithological gas pools, and paleoweathered crustal gas pools.

#### Foreword

China developed the world's first gas field (Ziliujing Gas Field) [1,2,3]. Up to now, several dozen gas fields and several hundred gas pools have been discovered.

China's gas fields (pools) have mainly developed in intracratonic polycyclic basins (such as the Sichuan Basin), intracratonic rift valley basins (such as the North China Basin), back-arc basins (such as the Taiwan Basin, the SongLiao Basin) and intermontane basins (such as the Qaidam Basin). The known deposits of natural gas in the two former types of basins constitute 93.2 percent of the national total. The deposits of natural gas in intracratonic polycyclic basins constitute 71.7 percent of the national total. In intracratonic polycyclic basins, the geostrata of deposition are thick, there are many depository cycles, and frequently there are many longitudinal gas pools. For example, 19 gas producing positions have already been discovered in the geostrata of the various periods of the Sichuan Basin. Many gas producing positions have been discovered even in one gas field. For example, seven gas producing positions have been found in the Wolonghe Gas Field. The depths of distribution of the gas pools in our nation range from 88.8 meters to 7,175 meters. The geothermal zone measured in present gas pools is from 10 to 177° C. The depths are shallower than the world's deepest gas producing layer (about 7,950 meters) [4] at present and the temperature is lower than that of the gas pool with the highest temperature (250° C) [5].

China's natural gas pools are distributed in most of the geostrata from the Quaternary System to the Sinian System. Gas pools have also been discovered in the weathered crust of mixed granite of the Pre-Sinian Period.

At present, the output of natural gas in China is not large. This is related to the low degree of prospecting. A comparison between the maximum depth and the maximum geothermal temperature of existing gas pools in China and those of foreign nations shows that the potential in prospecting for natural gas in China is still great. Analysis of intracratonic polycyclic basins with the greatest amount of gas deposits in China and abroad shows that here, only the Sichuan Basin has been prospected for natural gas to a slightly higher degree. Therefore, prospecting for natural gas has a very bright future.

The types of gas pools already discovered at present in our nation (not including oil and gas deposits) can be categorized into seven types in three groups and several other types. The various types of gas pools are described below:

#### I. Structural Gas Pools

Tectonic factors exert a leading function in the formation of gas pools. Tectonic factors refer to anticlines, synclines and rifts.

1. Anticlinal type. There are syngenetic, compression and overlapped compact types. The gas pools are frequently found at the axis. This type can be further divided into the following:

(1) Dome type. The structure is relatively even and gentle. In general, the ratio between the long and short axis is 2 to 3, and this type occurs in regions of relatively stable structures. Faults are not developed, or they generally do not affect the uniformity of the gas pools. There is a uniform gas and water (oil) boundary. Examples are the Tiezhenshan-Tongxiao condensate gas field in the Taiwan Basin, the Sebei No. 2 gas field, the gas pool of the Quaternary in the Qaidam Basin, and the Weiyuan Gas Field in the Sichuan Basin.

(2) Faulted fold type. The structure is more precipitous and even inverted. The ratio between the long and short axis is greater than 3. Faults are more developed, but the uniform gas and water (oil) boundary inside the structure is not destroyed. The gas pool is still a unified body, such as the Jiawu-Jiaxi gas pools of the Wolonghe Gas Field in the Sichuan Basin.

(3) Rolling type. This type frequently occurs in groups in depressions or at the bottom walls of the main faults of secondary tectonic belts. It is the product of gravitational collapse and twisting when syngenetic faults settle. The gas (oil) pools are limited by the high point of the structure, each of the upper and lower gas (oil) pools has its independent gas (oil) water boundary [6], for example, the first section of the Qijiasha gas pool and the fourth section of the Baimiaosha gas pool.

2. Synclinal type. The axis of the syncline and the axis of the anticline are at positions of similar stress, therefore, the axis of anticlines

developed tension crevasses, similar to the axis of synclines (but generally the surrounding pressure where the axis of the syncline is located is greater than that of the axis of the anticline, therefore the density and scale of crevasses are relatively less pronounced). Especially in compact depository layers with a low porosity, the axis frequently exerts a definite function in the concentration of oil and gas. For example, gas pools have been discovered in the Yunjing syncline and the Kuangchang syncline on the ancient Luzhou Upwarping. The Yunjing syncline has the Jiayi gas pool and the Yangsan gas pool. The latter includes two crevasse systems, the Yun No. 1 well and the Yun No. 8 well. As of the end of 1979, the Yun No. 1 well has produced a cumulative total of 15,142,000 cubic meters.

3. Fault-block type. The structures (anticline, syncline or monocline) have been cut and complicated by a series of faults. The gas pools have been cut by the faults and have lost their uniformity. The gas (oil) and water boundary is more complex. The boundary of gas and water of each fault block is frequently high at one place and low at another place. The gas containing positions vary. The thickness of the gas layers are not uniform. Longitudinally, "string of pearls" type concentrations of gas frequently are formed near the faults. The composition of natural gas sometimes shows a characteristic of vertical migration, such as the condensate gas pools of Banqiao (with oil rings).

## II. Lithological Gas Pools

1. Bioherm type. Gas pools are mainly controlled by bioherm or banks. This type of gas pools was discovered for the first time in China in the reef blocks and banks of reef of the second section of the Changxing Group of the Jiannan Gas Field. The bioherm gas pools of the second section of the Changxing Group of the northern high point in the Jiannan Gas Field are in the spotted reefs, similar to the bioherm discovered in recent years on the ground surface at Huangnitang, Jiantianba, and Huajiaoping [7] near this region. Characteristics of the bioherm here show that the biological content is high, averaging 43 to 49 percent. The main body of lifeforms creating the reef constitutes over 75 percent of the total [8]. The reef-building lifeforms consist mainly of sponge and blue green algae and there are small quantities of bryophyte and tubular algae. Life forms attached to the reef include foraminifer and echinoderm. The reef is thicker than the sediments of the same period. The second section of the Changxing Group of non-reef facies next to it is generally 107 to 120 meters thick while the reef block is 139.5 to 156.5 meters thick. The reef is block shaped without stratification. Blue green algae wind around the sponge and grow into a twining structure. Sponges concentrate and pile up to form a frame structure. These two structures cause the reef to form holes between frames and algae poles in the course of growth, and there is a large primary porosity. They provided favorable conditions for later secondary dolomitization. The pores are developed and they are the major locations for reserves and seepage of gas pools. For example, the Jien No. 40 well at the center of the reef has a dolomite porosity reaching 14.6 percent. The porosity in the reef is far greater than the sediments outside the reef. This is the reason that this gas pool produced a high output and the top part of the northern high point did not

form gas pools. Gas pools are mainly controlled by the body of the reef. The residual height of the reef at present is 156.5 meters. Because of tectonic influence, the eastern part of the reef slants downward and there is water along the side. The water and gas boundary is 2,580 meters.

2. Lithological type. This type refers to trapped gas pools formed by variation in porosity and permeability (structure and composition of the depository layer) of different lithological character and (or) the same type of lithological character.

(1) Lens type: Gas pools are inside lens shaped or dyke shaped depository layers, such as the gas pools of the Sha'er section of the Rehetai Oil and Gas Fields, gas pools (in the sand banks at the mouth of the river) of the Xianger section of the Sui No. 8 well in the Suinan Gas Field.

(2) Upward slanted thinning out type. This type is distributed on the wings or the walled inclines of nose structures and monoclines or upwarps (anticlines). The depository layer thins out in a wedge shape in the direction of upward slant of the structure. Gas pools of this type are more developed towards the lower part of the structure, such as the gas pools of the Kongyi section and the Shasi section of Zhaolanzhuang. The gas pools of Zhaolanzhuang are mainly developed in the geostrata of the carbonate-sulfate formations. They contain intercalated beds of mudstone relatively rich in organic matter. The main gas pools are in the dolomite of the Kongyi section (upper dolomite section) and the Kongsan section (lower dolomite section). The  $H_2S$  content in the gas pools of the Kongyi section reaches as high as 92 percent. They have already become  $H_2S$  gas pools. This is also rarely seen in the world.

### III. Paleoweathered Crustal Gas Pools

The paleoweathered crust beneath the nonconformity boundary and the pseudo-conformity boundary, whether it is formed by igneous rock and metamorphic rock or carbonatite, always may have good depositing characteristics. It has provided a good place for the concentration of oil and gas. The gas in this type of gas pools is secondary. The migration and concentration of gas are mainly sideways and in the reverse vertical direction.

According to related references [9] and achievements in prospecting for oil and gas, we can summarize the types of weathered crusts and their properties of oil and gas content as shown in Table 1.

Hong Qingyu [3076 1987 3768] started out from the energy coefficient (referring to the amount of energy needed to destroy or produce 1 gram of minerals or rock) and the energy of weathering of rock and studied internal causes that affected weathering. He pointed out that magmatic rock and metamorphic rock are more easily weathered [10] than clay rock and sandy rock under the same weathering conditions. Therefore, categorizing paleocrustal oil and gas pools based on the types of weathered crusts of various types of mother rocks is more feasible. Of course, other classifications can be used for composite categorization.

Table 1. Classification of Weathered Crusts and the Oil and Gas Content of Paleoweathered Crusts

Weathered crust categories	Classification indicators	Characteristics	Characteristics of longitudinal zones	Oil and gas content of paleoweathered crusts
Modern weathered crust	Time	Formed in Quaternary Period; emergence on modern surface or nearby		No oil or gas pools
Paleoweathered crust		Formed during Pre-Quaternary Period		Possible oil or gas pool formation
Open (exposed) weathered crust	Conditions of closing and burial	Emergences on ground surface or buried shallowly and affected by surface water		No oil or gas pools
Closed (buried) weathered crust		Buried deeply, not affected by surface water		Possible oil or gas pools
Normal weathered crust	Lithological character of mother rock	Mother rock is igneous rock	Divided from bottom to top: 1. Disintegrated zone 2. Eluvial zone 3. Hydrolytic zone 4. Final hydrolytic zone Has definite zonal characteristic	Bottom of some disintegrated, eluvial, and hydrolytic zones have better oil depositing properties, can frequently form oil and gas pools
Quasi-weathered crust		Mother rock is metamorphic rock		More oil and gas pools
Karst weathered crust		Mother rock is carbonatite		Possible oil or gas pools
Secondary weathered crust		Mother rock is argillaceous rock and sandy rock (including some other sedimentary rocks)		May form relatively stable oil and gas pools
Surface-type weathered crust	Shape of occurrences	Weathered crust shows broad area development		They have frequently formed more complex oil and gas pools
Linear (strip) type weathered crust		Developed on tectonic rift belts or contact belts, the intensity of weathering gradually weakens from the center outward and occurrences are narrow and long wedge shapes or pockets and irregular shapes, sometimes at great depths		
Linear (strip)-surface type (mixed) weathered crust		A combination of the two types of weathered crusts described above, it has developed on intensively active tectonic belts		

Because the degree of prospecting for natural gas in our nation is low, at present, only the following types of paleoweathered crustal gas pools have been discovered.

1. Linear surface type paleo-metaweathered crustal type. This is a type of gas pools that have developed in the linear surface type weathered crust of metamorphic rock. For example, the Qijia gas pool of the Liaohe Oil Field is developed in the weathered crust of mixed granite 1.68 billion years old (Qi No. 11 well), using isotope dating. Here, weathering of the top part of fragmental biotite mixed with granite is severe, and there are indications of oil and gas in the surface type weathered crust of feldspar which has weathered to become kaolin. There are also thin layers of fragmental biotite mixed with granite and intercalated beds of basalt. Fragmentation is developed. Parts of the basalt are more severely weathered. Many oil and gas indications have been discovered in it, and industrial gas flow containing condensate oil has been obtained. The thin layers of basalt sandwiched between mixed granite may be the veins distributed along rifts of mixed granite. Because they are distributed along the rifts and constitute the contact belt of different lithological character, they favor the development of linear weathered crust. The summary of the characteristics of weathered crust of mixed granite mentioned above shows that a gas pool of linear surface type paleo-metaweathered crust has developed here.

2. Karst paleo-weathered crust type. Carbonatite underwent paleo-karst formations to form karst caverns, karst holes and karst passageways which then stored oil and gas. According to the form of occurrence of paleo-weathered crusts, this type of gas pools can be divided into the following:

(1) Surface type Karst paleo-weathered crustal gas pools. The gas deposits are in the surface type karst paleo-weathered crust. Generally there is a uniform gas (oil) and water boundary, such as the gas pools [11] of the lower Ordovician Series of the Longnusi Upwarping. It arose after the sedimentation of the Ordovician System and emerged from the ground surface in the Permian Period or before the Carboniferous Period. After a long period of weathering and karst formation, a widely distributed surface type weathered crust was formed and conditions for gas pools were formed.

(2) Wells of gas pools of linear type karst paleo-weathered crust frequently extend downward at a relatively large angle of inclination (even vertically) and disappear. Lateral variations in porosity and permeability of the depository layers are large. Several gas pools of this type in the same structure do not have a uniform gas (oil) water boundary, and in high structures, gas and water are produced together while low structures produce pure gas. Some gas pools of the Yangxin Series in the Sichuan Basin, such as Yangsan of the Naxi Gas Field, have 13 gas pools in the fissure system. Some of them are linear type karst paleo-weathered crustal gas pools. Now, let us use the eastern high point of the Naxi structure to explain the characteristics of this type of gas pools.

Fifteen wells of the Yangxin Series have been drilled in this region. In six wells, five linear type karst paleo-weathered crustal gas pools have been

found. The gas pools do not interfere with each other. In the past, it was believed that these gas pools were mainly "fissure type anticlinal layered gas pools," "fissure type gas pools" controlled by rifts, and it was also believed that a rational principle in distributing prospecting wells was "occupying three pints and following along three lines" (i.e., occupying high points, occupying fault blocks, occupying the saddle positions; along the axial line, along rifts, along the belt of precipitous and gentle variations which are more favorable positions for the development of gas pools).

After drilling and prospecting, it was discovered that some new situations have emerged in the understanding of the original gas pools. For example, the Na No. 16 well is right next to the high point of the structure, and logically, fissures should be developed, but actually, crevasses are not developed. After two acidifications, only a slight amount of gas was produced. At the same time, the positions where water and gas were simultaneously produced showed abnormalities. The lower positions produced pure gas while the higher positions produced gas and water simultaneously.

If we use the linear type karst paleoweathered crustal gas pools to explain it, the above question could be explained better. The writer agrees with the following opinion: The Dongwu Movement caused the Yangxin Series of the Sichuan Basin to undergo a paleokarst formation, and a "central karst highland" subjected to the most violent karst formation was formed in the Nanchong to Luzhou area. Here, tension joints of the early period are developed. The ancient underground hidden water surface is generally greater than 200 meters and "karst funnels" with underground hidden water surface deeper than 300 meters were formed in some areas.\* The eastern high point of Naxi is within the central karst highland. The five gas pools described above are in the linear karst paleoweathered crust of the Dongwu Period and they have developed along the belt of tension joints. These belts of joints developed before the formation of the anticlines, therefore, their direction is unrelated to the present structures. Every linear type paleoweathered crust was originally filled with sediments or was filled with sediments during later periods and actually formed independent systems.

The formation of each gas pool was also different. Some linear type weathered crusts passed through the top erosion surface of Yangxin Series and the Silurian System and joined them together. Gas migrated from below. Some were pools of gas and water formed by the formation of coal during the middle and latter period of sedimentation of the Longtan coal series. Some were pools of oil, gas and water formed from the carbonatite of the Yangxin Series and migrated and concentrated towards the linear paleoweathered crust. Folds\*\* in the east-west strike and the north-south strike of the Naxi structure formed separately in the early and late periods of the Yanshan Movement, and related rifts and small faults formed along the weak areas of the linear

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\*Song Wenhui [1345 2429 3189] et al, Research Report on the Sedimentary Facies of the Yangxin Series in the Sichuan Basin and Its Conditions of Oil and Gas Deposits, 1979.

\*\*Liu Fanghuai [0491 2455 2849] et al, Brief Summary of the Work Phase of Geological Research of the Yangsan Gas Pools of the Naxi Gas Field, 1975.

paleoweathered crusts by dissipating some stress by accommodation, thus some areas (such as Na No. 16 well) subjected to stronger stress could not produce a large number of fissures because a relatively large portion of the stress was released. Although the Yanshan Movement reformed the gas that originally concentrated to varying degrees or destroyed some, such activity occurred only with the concentrations of gas in linear paleoweathered crusts. Because each linear paleoweathered crust is an independent system, the gas pools formed also retained their own characteristics.

The winding paleoweathered crustal gas pools were partially or completely sealed under the filling of calcite and retained the pressure of the geostrata at the time of sealing. Because of denudation by later tectonic upwarpping, the pressure in the gas pools of these linear paleoweathered crusts surpassed normal and became ultrahigh pressure gas pools. This is the cause of some ultrahigh gas pools in Sichuan.

A standard example of the linear karst paleoweathered crustal gas pool is the No. 1 karst cavern of the horizontal tunnel at 390 meters in the Zhongliangshan Coal Mine in Sichuan. It extends upward for 7 meters and downward very deeply. It is a large inclined cavern crevasse. From the time it was found in mining coal on 4 September 1960 to June 1965, it produced a total of 123 million cubic meters of gas.

This article comprehensively utilized a lot of information on oil and gas field production and of scientific research units. Chief geologist Situ Yuwang [0674-1778 1937 2489], and Comrade Zhang Zhijun [1728 0237 0193] have provided invaluable suggestions for revision. Thanks.

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9296

CSO: 4013/169

## OIL AND GAS

### BRIEFS

DAQING OIL PRODUCTION--As of today, the Daqing Petroleum Administrative Bureau in Heilongjiang has produced 26.48 million tons of crude oil this year, fulfilling 51.1 percent of the annual target. Other major production and construction targets for oil processing, sub-surface work, oil extraction construction, and tax and profit have also been fulfilled. [Excerpt] [SK031041 Harbin Heilongjiang Provincial Service in Mandarin 1100 GMT 30 Jun 83 SK]

XINJIANG CRUDE OIL PRODUCTION--Output of crude oil produced by the Xinjiang Petroleum Management Bureau by 27 June was some 2,055,000 tons. The bureau overfulfilled the state production quota for the first half of this year. It has stepped up both putting new oil wells into operation, and tapping the potential of old oil wells. At present, 160 new oil wells have been put into operation, resulting in greatly increased daily output of oil. [Summary] [Urumqi Xinjiang Regional Service in Mandarin 1300 GMT 27 Jun 83 HK]

HENAN GAS PIPELINE--Zhengzhou, 13 May (XINHUA)--The construction of a gas pipeline from the Zhongyuan Oilfield to Kaifeng, Henan, started on 11 May. With a total length of 148 km, the pipeline will be able to transmit 115 million cubic meters of natural gas a year. The entire project is expected to be completed during the first half of 1984. All the natural gas through this pipeline will be used by the Kaifeng Chemical Fertilizer Plant. [Summary] [OW180949 Beijing XINHUA Domestic Service in Chinese 1214 GMT 13 May 83 OW]

SEMI-ANNUAL PETROLEUM QUOTA EXCEEDED--Beijing, 24 Jun (XINHUA)--China produced 50.12 million tons of crude oil by 23 June, meeting its semi-annual quota 7 days ahead of schedule, the Ministry of Petroleum Industry reported today. The figure represents an increase of 2.67 percent over the same period in 1982, the ministry said. Daqing, China's leading oil field in Heilongjiang Province, fulfilled the state plan despite a heavy snowfall which suspended operation of 5,700 oil wells in late April. Heavy rain also hit Shengli Oilfield--another major producer in Shandong Province--on 16 April, stopping work on 1,060 oil wells for 3 days. Workers brought production back to normal levels and exceeded the semi-annual target by 364,000 tons. [Text] [Beijing XINHUA in English 1412 GMT 24 Jun 83 OW]

CSO: 4010/82

## NUCLEAR POWER

### SYMPOSIUM FOCUSES ON CRITERIA, SPECIFICATIONS FOR NUCLEAR POWER PLANT SITE SELECTION

Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 6, 5 Jun 83 pp 61, 23]

[Article by Chen Guanhua [7115 0385 5478]]

[Text] A symposium on criteria and specifications for nuclear power plant site selection convened jointly by the Chinese Electrical Engineering Institute, the Chinese Nuclear Science Institute, the Chinese Geological Institute and the Chinese Seismology Institute, was held from 6 to 11 April this year in Fuzhou City. The joint convening of the conference by the four institutes was a new attempt which has accumulated experience for the future. One hundred thirty comrades from 68 units from around the entire nation attended the symposium. Mainly discussed at the conference were "Provisional Criteria for Nuclear Power Plant Site Selection" (abbreviated hereafter as "Criteria"), drafted by the Hydroelectric section of the Suzhou Thermodynamic Engineering Research Institute, and "Safety Specifications for Nuclear Power Plant Site Selection" (abbreviated hereafter as "Specifications"), drafted by the Second Research and Design Institute of the Ministry of Nuclear Industry. The contents of these were thus made even more substantial and complete; the papers were then recommended to pertinent departments to consider their adoption or trial implementation.

The conference began with a presentation of the main content of and an explanation concerning the writing of "Criteria" and "Specifications" by the two units which drafted them. Specialized papers in the areas of geology and seismology were presented to the conference, then five separate groups (general, seismology and geology, hydrology and hydraulic engineering, environmental protection, and methods of writing criteria and specifications) were formed and discussions were held. A report of the discussions was then presented to the conference.

The conference believes that in the areas of formulating and establishing standards and specifications for nuclear power in China, there should be a long-range, comprehensive system with standards and specifications. For this, the two levels management systems recommended by the International Atomic Energy Agency (IAEA) may be referred to. The first is called specifications; these are requirements of principle. The second is called guidelines, which are specific requirements or quantitative requirements. However, from the point of view that at present nuclear power is in its

beginning stage in China, and many areas have already begun to conduct the practical work of site selection, a criterion for plant selection is urgently needed. Because of this, "Criteria" was decided upon as the chief source, "Specifications" was referred to to conduct revisions, and the work was entitled "Provisional Safety Rules for Nuclear Power Plant Site Selection." After being revised by the person who originally drafted it, it was handed over to four experts chosen by the conference to read and edit the final manuscript from the group; and work on "Specifications" should continue to be conducted.

The conference suggested that from now on symposia on criteria and specifications in areas concerning nuclear power plant design, quality assurance, operation and so forth, should be jointly convened by the Chinese Nuclear Society, the Chinese Electrical Engineering Society, and the Chinese Mechanical Engineering Society, in order to continually substantiate the criteria and specifications required by China's nuclear power plants.

The conference also suggested, as China's nuclear power plants are now about to enter a period of rapid development, that the nation establish a nuclear safety administration organization, or designate an existing organization to be responsible for implementing unified monitoring and administration of nuclear power safety.

12326

CSO: 4013/259

## CONSERVATION

### NINGXIA'S ENERGY DEVELOPMENT SCHEME LAYS HEAVY STRESS ON CONSERVATION

Yinchuan NINGXIA RIBAO in Chinese 22 Mar 83 p 2

[Article by Yan Changping [7346 2490 1627]: "Earnestly Implement Development and Conservation Policies With Equal Attention; Suggestions To Resolve Ningxia's Energy Problems"]

[Text] Resolving the energy problem is one key to achieving the objective that was raised by the 12th Party Congress of the CCP to quadruple the yearly overall industrial and agricultural production value by the end of this century. From actual conditions in Ningxia we can see that we should earnestly implement and strengthen energy development, energetically conserve on energy consumption, and put energy conservation in a position of top priority.

Ningxia's energy resources are extremely plentiful. Verified coal reserves are now the fifth largest in the nation, and hydropower can be developed on the stretch of the Huang He that flows through the region between Heishanxia and Qingtongxia. Already-proven oil resources can also be tapped. Ningxia's solar energy resources are also rather abundant--the sun shines 3,000 hours a year. Yearly square meter radiated heat reaches 1 million to 1.4 million kilocalories.

Abundant energy resources are a major attribute of Ningxia. How can this superiority be developed over the next 20 years to accelerate the build-up of energy resources? First, based on this characteristic of building long-term energy resources, we must intensify the early stages of preparation work in developing energy resources, and new construction and expansion projects in long-term planning also should be thought out early. Second, we must unify coal development, and build several large-scale pit-mouth power plants to enable Ningxia to gradually become a power base in the northwest region. The annual yield of raw coal in Ningxia now exceeds 10 million tons, but the region can only consume 30 percent of this amount; the remaining 70 percent of the coal must be shipped by rail to various other regions throughout the country. Due to the limitations of railroad transportation, the trend for Ningxia to follow in the future should be to build pit-mouth power plants along with the construction of mines, generating

electricity from the coal produced which may then be transmitted to other provinces and regions. Third, the installed capacity of the region's power grid is 520,000 kilowatts, of which the installed capacity of hydroelectric power comprises more than half. Because hydroelectric output fluctuates with the flow of the Huang He, the amount of electricity generated during the low water season drops greatly, creating periods of tight supply in which demand cannot be met. But as more electricity is generated during the high water season, we then have more power than is needed, and the reservoirs of the hydroelectric stations are forced to release water. In order to rationally resolve this contradiction and reduce the waste of hydroelectric power resources, we must try as quickly as possible to link our grid with that of Shanxi, Gansu, and Qinghai. Fourth, in the southern mountain regions of Ningxia that are short on energy resources, we can adopt policies of "self-construction, self-use, and self-management" in various counties in the near future, and in the river valleys of the Qingshui He, the Hulu He and the Jing He, we should construct some small-scale power stations where engineering is minimal, investment is economical, and it becomes effective quickly.

Since the establishment of the autonomous regions, we have made considerable progress in the development and construction of energy resources in Ningxia. Of the energy that is produced in Ningxia each year, aside from 30 percent consumed within the region, the remaining 70 percent is all used to support the construction of industry and agriculture in other provinces and regions. Under these advantageous conditions, the work of saving on energy consumption continuously has not received enough attention in various areas; the revenue realized from a unit of energy is much lower than in many provinces and the energy waste is alarming. In an appraisal and inspection of 41 major power consumers in this region conducted recently by the "San Dian" office of the autonomous region, 33 enterprises exceeded the power consumption [norms]. For major power consumers, the amount of power used by chemical fertilizer units exceeded the standard set by the state. For calcium carbide, the state stipulates that each ton consumes 3,650 kilowatt-hours, but the amount of power used for each ton by the Yinchuan Calcium Carbide Plant and the Shizuishan Calcium Carbide Plant goes as high as 4,380 and 3,873 kilowatt-hours respectively. The amount of power consumed for products such as ferroalloy and electric steel is also much higher than the standard set by the state. According to statistics, the consumption standard for 100 million yuan in output value in Ningxia is 140,000 tons of coal, 49,000 tons higher than the national average, and four to five times higher than advanced provinces and municipalities like Shanghai, Zhejiang, and Liaoning.

The potential to economize on energy resources in Ningxia is enormous, and there are many ways to do it. In the present process of comprehensively reorganizing enterprises, various enterprises should strengthen energy resources management, eliminate or transform old equipment that has high energy consumption, popularize new energy-saving technology and techniques, implement the system of economic responsibility for energy use, strive for the yield from a unit of energy resource and the revenue that is created to reach

or exceed the highest level in history, and later gradually forge ahead of the level of advanced provinces and regions. At the same time, we must work hard to improve product quality and reduce waste products, to achieve good results from indirect energy conservation. Additionally, in the near term it is inadvisable for Ningxia to build enterprises that use a lot of energy such as ferroalloy plants and calcium carbide plants. For the enterprises with poor management and administration that cannot reduce energy consumption in the long term, they should be shut down, consolidated and transferred.

12310

CSO: 4013/238

## CONSERVATION

### BRIEFS

ENERGY CONSERVATION BANK LOANS--Beijing, 26 Jun (XINHUA)--About 600 energy conservation projects have gone into operation throughout China as a result of bank loans, the People's Bank of China has reported. In the past 2 years, a spokesman for the bank said, branches of the bank have extended 500 million yuan (about 250 million U.S. dollars) in loans for construction of 1,700 energy projects. When completed, the projects will be able to save annually 2 million tons of coal, 190,000 tons of petroleum, 700 million kilowatt-hours of electricity and 3 million cubic meters of gas. Energy conservation now has top priority in China's energy policy which stresses the exploitation of energy resources as well as the practice of economy in energy consumption, according to earlier reports. The loans are being used to replace outdated boilers and other low-efficiency equipment, the spokesman said. Plants are encouraged to adopt central heating systems and utilize exhaust heat to generate electricity. [Excerpt] [Beijing XINHUA in English 0709 GMT 26 Jun 93 OW]

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